MARCH, 1905. BULLETIN 226.

CORNELL UNIVERSITY.

AGRICULTURAL EXPERIMENT STATION OF

THE COLLEGE OF AGRICULTURE.

Department of Horticulture (Extension Work).

AN APPLE ORCHARD SURVEY

OF

WAYNE COUNTY, NEW YORK.

UNDER THE DIRECTION OF

JOHN CRAIG.

PART I — THE APPLE INDUSTRY,

BY G. F. WARREN,
Fellow in Agriculture.

PART II — GEOLOGY,

BY W. E. McCOURT,
Fellow in Geology.

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Office of the Director, 17 Morrill Hall.

The regular bulletins of the Station are sent free to persons residing in New York State who request them.

College of Agriculture, Cornell University,
Ithaca, N. Y.

Hon. Charles A. Wieting, *Commissioner of Agriculture:*

Sir.—At the first annual meeting of the Fruit Growers' Society of Western New York, held at Rochester in January, 1856, the following question was a subject of lively debate: "Can the cultivation of fruits for market on an extensive scale be recommended to the farmers of Western New York?"

One of the most emphatic parts of the discussion was that contributed by Patrick Barry, who explained the westward trend of wheat-growing and called attention to the natural advantages offered by Western New York for commercial fruit-growing. He opened his discussion as follows: "I would answer without the slightest hesitation—*yes*. The circumstances in which Western New York is placed to-day are quite different from those of a few years ago. The Great West has been opened up by railroads, and the farmers of Illinois, Wisconsin, and the Western States can send forward their wheat and other grain crops to the seaboard with rapidity and at cheap rates. This has created a vast competition for our farmers.

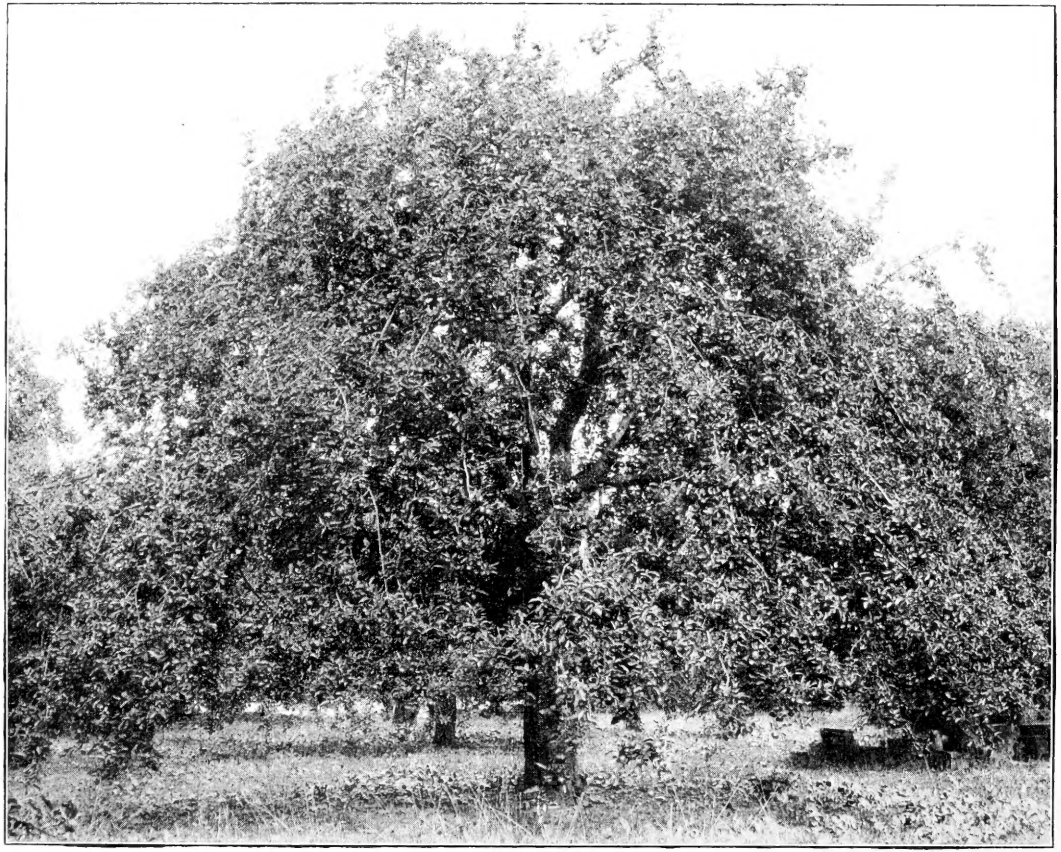
"Here our farming lands are worth from $50 to $100 per acre, while they are worn and need manure. In the West the richest and finest soils under the sun can be bought for $4 or $5 per acre, ready for the plow. The weevil, too, of late years has made sad work with the wheat crops; and is it not high time that the farmer should make some inquiry concerning other objects of culture to which he may appropriate his lands and invest his skill and capital to greater advantage?

"It seems to me it is, and I think this society should come forward and suggest a more extensive culture of fruits."

Mr. Barry's opinions were challenged; but time has seen the fulfilment of them. It is now our privilege, after the lapse of about fifty years, to begin a survey to determine what the status of this great fruit industry has come to be.

The work herein described was performed in the season of 1903; and this Bulletin comprises a part of the annual report of that year.

L. H. Bailey,
Director.



FRONTISPIECE.—*An ideal Baldwin apple-tree for Western New York.*

PREFACE.

At the summer meeting of the New York State Fruit-Growers' Association held at Olcott Beach in 1902, the writer made the suggestion that a careful survey of the principal orcharding regions of the State should form a definite part of the function of the society. The suggestion met with the approval of the executive, but could not be carried out for lack of men and funds. While the project, of necessity, lay dormant with the society, its importance was immediately realized by former Director Roberts of the Cornell Experiment Station, who, the following year, gave the necessary authorization and provided the funds from Experiment Station resources to make a beginning, and the work was started in June, 1903.

Purposes of an orchard survey.—The purposes of such a survey are manifold:

1. To correlate geologic and soil characters with orchard conditions.

2. To compare successes and failures, and ascertain underlying causes.

3. To investigate methods of orchard management and determine the influence of each.

4. Finally, and in short, to collect and tabulate such a mass of data upon practical apple-growing, as will place many moot questions beyond the range of peradventure and furnish indisputable evidence for the assistance of those who are horticultural leaders and teachers.

The benefits of feeding, of tillage, of pruning, of spraying are admitted by many; but, as a matter of fact, the knowledge is made use of by comparatively few. We hear much of the occasional progressive and successful orchardist with his twenty-five to fifty acre well-cared-for orchard, but we do not hear of scores of apple-growers maintaining from five to ten acres, who are not convinced at heart that spraying pays, that the tree needs feeding for the apples it bears, or that there is anything in pruning aside from lopping off a limb at a convenient place when it interferes with a wagon, or another limb. Such masses of facts as may be collected by examining the soil and condition of

growth of the trees in hundreds of orchards, and the uncompromising conclusions which the results of tabulations furnish, are needed to convince those persons who are unmoved by "comfortable theorizing." Such facts are furnished in abundance in the following pages. They corroborate the best teachings of Cornell and other experiment stations during the past ten years, and should furnish a great incentive toward the wiser management of our apple orchards in this great apple-growing State.

How the survey was conducted.—The work was placed in the immediate charge of Mr. G. F. Warren, who, equipped with an experiment station credential (which he was never called upon to use), a soil auger, note-book and camera, all mounted on a bicycle, made a beginning at Walworth, in Wayne county, in June, 1903.

Scope of the survey.—At first we planned to examine every orchard in the county. This we found to be impracticable after a month had been spent in the single township of Walworth. Mr. Warren spent three months in the county, and, after examining every orchard in Walworth township, investigated nearly all above five acres in extent in the townships adjoining on the north and the south. This carved off a characteristic strip of country from the west end and furnished a mass of data, from one carefully examined section, with which to compare other data collected in a less concentrated manner.

The work was started at Walworth, for here it was that orcharding received its greatest impetus in the county. Sixty years ago there were large numbers of small seedling orchards scattered about, bearing good, bad and indifferent fruit with practically no care. Such were the conditions when T. G. Yeomans moved to Wayne county and became interested in fruit-growing. He soon started a nursery and for nearly half a century the firm of T. G. Yeomans & Sons grew apple-trees and urged the planting of apple-trees upon their neighbors. The senior member of the firm set the example himself by planting more than one hundred and twenty-five acres of apples. Baldwin, Greening, King, Spy, Spitzenburg and Roxbury Russet were, and are to-day, leading varieties in Wayne and the Lake Ontario counties. Mr. Yeomans believed in tillage and practiced it.

Acknowledgment.—To Mr. L. T. Yeomans and E. L. Yeomans, of Walworth, where the work began, we are much indebted for friendly counsel and helpful suggestions; to the fruit-growers of the county

we offer our thanks for the manner in which they met the "Experiment Station Agents" and freely placed at their disposal the results of such observations and experience as their years in orcharding had brought them. It is hoped that this pamphlet will in some measure return such favors as we gratefully acknowledge on behalf of the field workers.

John Craig.

PART I.

THE APPLE INDUSTRY OF WAYNE COUNTY, NEW YORK.

G. F. WARREN.

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INTRODUCTION.

GENERAL METHOD OF WORK.

The field work.—The field work was done between June 10 and September 12, 1903. Nearly all of this time was spent in the apple orchards.

In Walworth township, which is in the center of the west part of the county, every orchard as large as one acre was examined. In nearly every case the owner was interviewed for statistics on variety, age, fertilization, tillage, spraying, past troubles, yields, market, price, etc. The orchard was examined in order to determine the site, aspect, area, distance between trees, present treatment, present condition of health and crop, pruning, diseases, insects, etc. A three-foot soil auger was a part of the outfit, and frequent borings were made to determine the physical condition of the soil, texture, structure and the drainage conditions. Samples for laboratory analyses were taken of the different soil types. In short, an effort was made to study whatever factors enter into the successful production of apples. All the information obtained was entered in the blank report provided for that purpose (see Fig. 38). These reports are preserved in the Department of Horticulture for reference for the future worker and are, of course, not open to the public. The position and approximate size of each orchard with its number is shown on the map prepared by the United States Geological

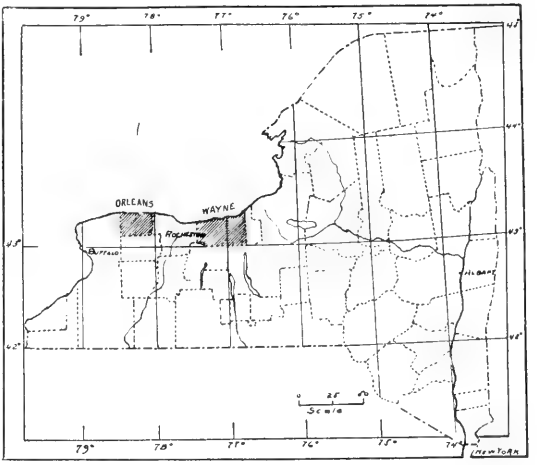

FIG. 37.—*Map showing the location of Wayne and Orleans counties, New York.*

APPLES. **ORCHARD SURVEY.** No. *Omitted.*

CORNELL EXPERIMENT STATION. Soil *2* *

[illegible] 1903.

Proprietor *Omitted.* *(Owner 10 yrs.)* P. O. *Omitted.* Wayne County.

Location *Omitted* When planted *1866.* How laid out *40 feet in row. Rows 20 ft. apart.*

Site *Level.* Aspect *Slight* [illegible]

Drainage *No drains. Eleven acres fair, natural. One acre trees drowned out.*

Varieties *On* [illegible] *Baldwin* [illegible] *Greening* [illegible]

How cared for *Entirely neglected and cattle pasture till 10 years ago. Tilled 9 years.*

Pruning *Formerly neglected and 6-inch stubs left. Now well pruned every other year.*

Fertilizer used *About 100 loads barnyard manure 9 years ago. Buckwheat plowed under nearly every year.*

Present Treatment: *Tilled. A cover crop of buckwheat to be plowed under.* Sprayed *Ordinarily, but not this year.*

Troubles: Past. [illegible]

Present. *Codling-moth bad. Considerable scab. Few aphis, canker, bucculatrix, leaf sewer.*

Present condition: Crop *Good.* Health *Good.* Thrift *Fair.*

	1900	1901	1902	1903	12 Acres
Yield, bushels		[illegible]	[illegible]	[illegible]	
Market and price	*Sold to dry, 14 cents.*	[illegible]	[illegible]	*Sold to dry, 2*[illegible] *cents.*	
Income per acre	$ [illegible]	$ [illegible]	$ 17.72	$ 50.85	

Has orchard been profitable? *Yes. Has paid nearly every year for* [illegible] *years.*

General observations: *This orchard was considered worthless 10 years ago, the neglect and canker having nearly ruined the trees. The canker is now nearly subdued and the trees are in fair shape, but are much too close together. The owner thinks of removing half of them. He is trying to keep up the orchard with cover crops and no fertilizer. Some manure or fertilizer would pay as the trees need a little more vigor. When the present owner* [illegible]

* *Refers to a description of this type. This number refers to the Miami stony loam.* Observer *G. F. Warren.*

FIG. 38.—*A sample report.*

Survey. These maps show the 20-foot contour lines on a scale of one inch to a mile (see Fig. 39). This method of locating the orchard makes it possible to look it up at any time in the future. Very many other items were determined, some of which were entered under "general

Fig. 39.—*A reduced photograph of the field map of Walworth township, showing the position and number of the orchards. This map was on a scale of four inches to the mile.*

observations," and some of which were recorded in a note-book kept for that purpose.

In Ontario township, which lies between the lake and Walworth, every orchard as large as ten acres and a number of smaller ones were likewise examined. Nearly all the other orchards were seen, and a comparison made with those that were carefully recorded.

In Macedon township, which extends from Walworth to the southern boundary of the county, every orchard as large as ten acres and nearly all of those as large as five acres were examined. Practically all the other orchards of this town were examined sufficiently to be able to make comparisons with those recorded.

These three townships gave a representative north and south section of the county. The differences in going north and south are very much greater than those from east to west.

The degree of accuracy of the reports.—The results are based on all the orchards of Walworth as large as one acre, or 443 orchards containing 1,773½ acres; and on 131 orchards of the remainder of the county containing 1,987½ acres. This is between one-fifth and one-sixth of the orchards of the county. Probably at least one-third of the orchards were examined more or less carefully. The careful records were made of the above number.

The location, site, aspect, area, distance between trees, present treatment, pruning, present condition, present troubles, soil and soil conditions were determined by the observer, aided by any suggestions that the owner might give.

The ages are a question of memory and sometimes of hearsay. The appearance of the trees would usually enable the inspector to avoid any large error. The past troubles except canker-worm, tent caterpillar and scab or "fungus" are not often given, as they are not recognized by many growers. This does not by any means indicate that no other important enemies have been present. Some have left their effects so apparent that the observer could, without difficulty, fill in the past troubles. The varieties, methods of former treatment, spraying, fertilization, etc., are fairly accurate, except that the amount of fertilization is not often known. The market and price per bushel are quite accurate. The farmers are practically all glad to be able to help in the work of the Experiment Station. They understand that the reports are confidential, and therefore have no incentive to give too high yields. The only limit to the accuracy is the memory of the grower. The apple crop is, however, the chief crop and is therefore well remembered. The yields are usually the result of measurement, as the people remember the number of bushels, or the number of pounds, or remember the income and price, from which the yield can be computed.

The yields for 1903 were secured by letters to the growers. They doubtless average too high, for those who had a very small crop sometimes considered it too small to be worth reporting.

The records of the 1902 yields are the most complete and the most accurate of all.

Method of making the computations.—Since every orchard in Walworth was examined, all computations have been made for this town by itself, and separate ones made for the south and for the north parts of the county. In some cases Ontario and Macedon townships were each considered separately. Nearly all these computations when yields are concerned are made for the crops of 1900, 1901, 1902, 1903. The conclusions have almost invariably been the same for each year and for each part of the county. In this bulletin they have, in most cases, been summarized under two heads, Walworth and the remainder of the county.

In computing yields under various methods of treatment, the yields of the orchards set before 1880 are ordinarily used. Trees set since that date have mostly not arrived at maturity.

In computing any one item the others have generally been ignored. The justification for this lies in the fact that so many orchards have been examined that other items will balance. For example, in determining the average yields for orchards having trees set at different distances apart, no attention has been given to the care of the orchard. There are orchards set at all distances that have been well cared for and others that are neglected. The large number examined makes an average of conditions. The danger of this method of making calculations lies in possible coordinate factors. The man who tills his orchard may be the man who sprays. Some points of this kind are discussed under the different chapters. To test the method, some computations have been made on the basis of sub-groups of orchards otherwise similarly treated. The results have sometimes been changed in absolute amounts, but have been unchanged in their relation to each other, or have been so slightly changed as not to alter the conclusions to which they point.

The independent calculations for Walworth township and for the north and the south parts of the county, furnish additional checks. There are usually twelve independent calculations—one for each of these divisions for each of the four years. When these results all

point to the same conclusion, they would seem to establish it beyond any reasonable doubt. In this report the results are frequently summarized in order to save space. There might seem to be some danger of a large orchard controlling the average, but in no case of any importance has such an orchard changed the relative order of the results.

In making most of the computations, there were orchards for which the information or yields were not secured. These were, of course, omitted, just as an orchard that was not seen. The computations always include every orchard for which the particular data were secured.

Work in Orleans county.—During the summer of 1904, orchards to the number of 564, including 4,881 acres, were similarly examined in Orleans county. In this county the writer was assisted by Mr. C. Bues. Some of the pictures in this report were obtained in that county. Many references are also made to it, but all the tabulations are from Wayne county. The tables for the Orleans county work will be published later.

General observations on the work.—The method of doing the work and the kind of information sought were much changed during the progress of the investigation. In the beginning the type of soil was thought to be of much more importance than it really is. The most important points were not considered in the first few reports. The relative importance of the different problems was better seen as the work progressed. The report blank (Fig. 38) is very different from the first one used. Many improvements were made when similar work was started in Orleans county, but there are others that will be made if another county is studied.

The succeeding pages may be said to be results of experiments of the past seventy-five years in apple-growing in Wayne county. "Every farm is an experiment station and every farmer the director thereof." But when these experiments are viewed singly, there are so many factors that the success or failure is as likely to be assigned to a wrong cause as to the right one. As a result we have the great diversity of opinion that exists among apple-growers. It is by studying and tabulating results from large numbers of orchards that important and unimportant factors can be properly correlated.

The standards in this bulletin are not ideals, but are in all cases based on what successful men are doing. No one man is following all of them, but each one has been tried. It is impossible to give credit to each

farmer who has aided in the work, for that would mean to enumerate six hundred in Wayne county and an equal number in Orleans county, but I can not refrain from mentioning the willingness with which nearly every one gave the information about his orchard and about his successes and failures. It would be very hard to find a region where the farmers are more willing to cooperate with every enterprise of the experiment stations. In writing this bulletin, I have tried to keep in mind the many questions asked by the farmers, as well as to present the tables of the results of various methods of treatment.

Making apple barrels.

Hauling the barrels to the orchard.

CHAPTER I.

The Magnitude of the Apple Industry.

Fruit production per capita.—The commercial demand in the United States for fresh fruit has been created during the past fifty years. The small quantity of fruit that was produced half a century ago was largely used for wine and cider manufacture, but fresh fruit and canned fruit are now among the staple articles of diet for the laborer as well as for the wealthy. Table 1 shows that the value of the orchard products on the farm has increased from 33 cents per capita in 1850, to $1.11 per capita in 1900. If all fruits are included the value would be about fifty per cent greater, the amount for 1900 being $1.74 per capita (see Table 2). Much more than these amounts must be spent

Table 1.

Relative increase of population and of value of orchard products from the census reports.

	Population.	Per cent of gain in 10 years.	Value of Orchard Products.	Per cent of gain in 10 years.
1850[1]	23,191,876	.....	$7,723,186	.....
1860	31,443,321	35.6	19,991,885	159.0
1870	38,558,371	21.3	38,000,000[3]	90.0
1880	50,155,783	32.4	50,876,154	33.9
1890[2]	.....	Gain in 20 yrs.	.....	Gain in 20 yrs.
1900	75,568,686	52.1	83,751,840	64.6

[1] Values of orchard products are for the year preceding the census.

[2] The value of orchard products was not given for 1890.

[3] "In 1870 the value of orchard products returned was $47,335,189. The reduction of this amount by the then existing premium on gold (25.3 per cent on the average for the twelve months of the census year, May 31, 1869, to June 1, 1870) would yield about $38,000,000." Tenth Census, Statistics of Agriculture, page xxii.

by the consumer for the transportation, commissions and profits increase the cost several times. A larger proportion of the crop may now be exported, but the great change has been in the creation of a home demand for fresh fruit, such as does not exist in any other country. The great fruit market of the world is the American workman, and his staple fruit is the apple.

The magnitude of the apple crop.—Of the total number of orchard trees reported in 1900, 55 per cent were apple, and these produced 83 per

TABLE 2.

Relative rank in fruit production of the ten leading fruit-producing states, from the census of 1900.

	ORCHARD PRODUCTS.			ALL FRUITS.		
	Total value.	Per cent.	Rank.	Total value.	Per cent.	Rank.
United States	$83,751,840	100.0	.....	$131,423,517	100.0	.....
California	14,526,786	17.3	1	28,280,104	21.5	1
New York	10,542,272	12.6	2	15,844,346	12.1	2
Pennsylvania	7,976,464	9.5	3	9,884,809	7.5	3
Ohio	6,141,118	7.3	4	8,901,220	6.8	4
Illinois	3,778,811	4.5	5	5,455,213	4.1	6
Michigan	3,675,845	4.4	6	5,859,362	4.5	5
Indiana	3,166,338	3.8	7	4,630,169	3.5	7
Missouri	2,944,175	3.5	8	4,309,813	3.3	8
Virginia	2,662,483	3.2	9	3,515,475	2.7	10
New Jersey	2,594,081	3.1	10	4,082,788	3.1	9

Leading fruit counties in New York.

	ORCHARD PRODUCTS.			ALL FRUITS.		
	Total value.	Per cent of the N. Y. crop.	Rank.	Total value.	Per cent of the N. Y. crop.	Rank.
Niagara	$1,078,042	10.2	1	$1,184,482	7.5	2
Orleans	830,732	8.0	2	875,270	5.5	6
Monroe	768,927	7.3	3	928,673	5.9	4
Wayne	584,254	5.5	4	903,875	5.7	5
Ontario	497,354	4.7	5	730,222	4.6	7
Dutchess	377,427	3.6	6	429,679	2.7	10
Ulster	354,262	3.4	7	989,024	6.2	3
Westchester	306,010	2.9	8	329,419	2.1	15
Columbia	300,645	2.9	9	434,660	2.7	9
Chautauqua	296,679	2.8	10	1,620,923	10.2	1

cent of the total number of bushels of fruit reported. The average production of apples is about two to three bushels per capita.

Of the crop of 175,000,000 bushels in 1899, the States of New York, Pennsylvania and Ohio produced nearly 69,000,000 bushels, or over 39 per cent of the total crop in the United States (see Table 3). New York justly claims first place in the quantity and quality of her apple crop. Apples are grown in nearly all parts of the State, but it is in the lake counties, Niagara, Orleans, Monroe and Wayne that the industry has been most extensively developed. In 1900, fifteen states outside of New York had a greater number of apple-trees than the combined number in these four counties, but only nine of these states gave a larger crop in 1899. No other county in the United States produced as many apples as any one of these. Only four counties: one in Illinois, one in Missouri and two in Arkansas had as many trees as any one of these.

The production of evaporated apples.—Wayne county has come to market the great bulk of its apple crop as evaporated apples. The other counties sell nearly all their crop in barrels. According to the last census (see Table 4), Wayne county produces over two-thirds of the evaporated fruit in New York, and produces an amount exceeded by only three states. Two of these, Oregon and North Carolina, only slightly exceed Wayne county. This report includes all kinds of evaporated fruit. Of evaporated apples, Wayne county doubtless produces more than any State in the Union, except, of course, New York (see Table 41).

Table 3.

Number of apple-trees and yield of apples, from the census of 1890 and of 1900.

	Census of 1890.			Census of 1900.		
	No. bearing trees 1890.	Bushels of apples for the year 1889.	Rank.	No. trees of bearing age 1900.	Bushels of apples for year 1899.	Rank.
United States	120,152,795	143,105,689	....	201,794,764	175,397,626	....
New York	14,428,381	8,493,846	7	15,054,832	24,111,257	1
Pennsylvania	9,097,700	7,552,710	10	11,774,211	24,060,651	2
Ohio	10,860,613	13,789,278	1	12,952,625	20,617,480	3
Virginia	4,253,364	8,391,425	8	8,190,025	9,835,982	4
Illinois	6,949,336	9,600,785	4	13,430,006	9,178,150	5
Michigan	8,582,386	13,154,626	2	10,927,899	8,931,569	6
Indiana	6,089,106	8,784,038	5	8,624,593	8,620,278	7
West Virginia	2,870,535	4,439,978	13	5,441,112	7,495,743	8
Missouri	8,150,442	8,698,170	6	20,040,399	6,496,436	9
Kentucky	5,730,144	10,679,389	3	8,757,238	6,053,717	10

TABLE 3—*Concluded.*

Leading Counties in New York.

	Census of 1890.			Census of 1900.		
	No. bearing trees 1890.	Bushels of apples for the year 1889.	Rank.	No. trees of bearing age 1900.	Bushels of apples for year 1899.	Rank.
Monroe	758,729	439,682	5	789,409	1,436,391	1
Niagara	1,033,454	623,204	2	924,086	1,421,796	2
Wayne	659,890	1,030,381	1	796,610	1,393,585	3
Orleans	591,767	321,726	7	629,401	1,391,630	4
Dutchess	288,762	194,916	13	400,811	990,244	5
Westchester	364,333	578,679	4	336,135	979,411	6
Ontario	425,236	591,073	3	419,483	933,764	7
Ulster	251,329	190,038	14	347,497	901,162	8
Chautauqua	460,111	175,704	15	449,317	825,633	9
Cattaraugus	366,536	32,999	43	434,319	718,201	10
Erie	730,458	65,212	37	631,283	476,091	15

TABLE 4.

Pounds of dried and evaporated fruit produced in 1899, from the census of 1900.

	Pounds of dried fruit.	Per cent.	Rank.
United States	144,804,638	100.0	
California	117,935,727	81.4	1
New York	3,658,610	2.5	2
Oregon	2,818,200	1.9	3
North Carolina	2,744,450	1.9	4
Tennessee	2,533,810	1.8	5

Counties in New York.

	Pounds of dried fruit.	Per cent of the N. Y. product.	Rank.
Wayne	2,698,350	73.8	1
Ontario	508,300	13.9	2
Yates	105,820	2.9	3
Monroe	87,160	2.4	4
Orleans	9,500	0.3	10

TABLE 5.

Value of orchard products, 1850 to 1900, from the census reports.

	1850.		1860.		1870.		1880.*		1900.	
	Value.	Rank.	Value.	Rank.	Value.	Rank.	Value.	Rank.	Value.	Rank.
United States	$7,723,186	.....	$19,991,885	.....	$47,335,189	.....	$50,876,154	.....	$83,751,840	.....
Alabama	15,408	23	223,312	21	37,590	36	362,263	30	476,574	28
Alaska	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Arizona	.....	.....	.....	.....	.....	.....	5,530	42	96,764	44
Arkansas	40,141	22	56,025	30	157,219	27	867,426	20	1,252,203	19
California	17,700	27	754,236	10	1,384,480	8	2,017,314	7	14,526,786	1
Colorado	.....	.....	.....	.....	9	43	3,246	44	378,119	31
Connecticut	175,118	13	508,848	14	535,594	22	456,246	28	1,011,359	21
Delaware	46,574	21	114,225	27	1,226,893	12	846,692	22	263,127	35
District of Columbia	14,843	28	9,980	35	6,781	40	12,074	41	773	51
Florida	1,280	33	21,259	32	53,639	32	758,295	24	192,893	40
Georgia	92,776	17	176,048	24	352,926	24	782,972	23	497,847	27
Hawaii	.....	.....	.....	.....	.....	.....	.....	.....	879	50
Idaho	.....	.....	.....	.....	725	42	23,147	40	365,224	32
Illinois	446,049	7	1,126,323	5	3,571,789	4	3,502,583	4	3,778,810	5
Indiana	324,940	9	1,258,942	4	2,858,086	6	2,757,359	6	3,166,338	7
Indian Territory	.....	.....	.....	.....	.....	.....	.....	.....	136,598	42
Iowa	8,434	30	118,377	25	1,075,169	13	1,494,365	11	1,849,767	13
Kansas	.....	.....	656	37	158,046	26	358,860	31	1,728,659	14
Kentucky	106,230	16	604,849	12	1,231,385	11	1,377,670	12	1,943,645	12
Louisiana	22,359	26	114,339	26	142,129	28	188,604	32	225,476	38
Maine	342,865	8	501,767	15	874,569	16	1,112,026	13	833,634	24
Maryland	164,051	14	252,196	20	1,319,405	9	1,563,188	10	1,266,047	18
Massachusetts	463,995	6	925,519	7	939,854	14	1,005,303	14	1,170,868	20
Michigan	132,650	15	1,122,074	6	3,447,985	5	2,760,677	5	3,675,845	6
Minnesota	.....	.....	649	38	15,818	37	121,648	35	109,050	43

*Values are for the crop preceding the census year. The value of orchard products is not given in the census report for 1890.

TABLE 5—*Concluded.*

	1850.		1860.		1870.		1880.*		1900.	
	Value	Rank	Value	Rank	Value.	Rank.	Value.	Rank.	Value	Rank.
Mississippi	$50,405	20	$254,718	19	$71,018	30	$378,145	29	$440,118	30
Missouri	514,711	5	810,073	8	2,617,462	7	1,812,873	8	2,944,175	8
Montana							1,530	45	59,414	45
Nebraska			125	39	9,932	39	72,244	37	684,751	26
Nevada					900	41	3,619	43	10,433	47
New Hampshire	248,563	11	557,934	13	743,552	19	972,291	15	707,729	25
New Jersey	607,268	4	429,402	17	1,295,282	10	890,090	21	2,594,981	10
New Mexico	8,231	31	19,051	34	13,600	38	26,706	39	197,331	39
New York	1,761,950	1	3,726,380	1	8,347,417	1	8,409,794	1	10,542,272	2
North Carolina	34,348	25	643,688	11	394,749	23	903,513	18	1,269,614	17
North Dakota									1,061	49
Ohio	695,921	3	1,920,309	2	5,843,679	2	3,576,242	3	6,141,118	4
Oklahoma									245,990	37
Oregon	1,271	34	478,479	16	310,041	25	583,663	27	906,015	23
Pennsylvania	723,389	2	1,479,937	3	4,208,004	3	4,862,826	2	7,976,464	3
Rhode Island	63,994	18	83,691	28	43,036	35	58,751	38	155,571	41
South Carolina	35,108	24	213,989	22	47,096	33	78,934	36	272,794	33
South Dakota									29,568	46
Tennessee	52,894	19	305,003	18	571,520	21	919,844	17	1,479,915	15
Texas	12,505	29	48,047	31	69,172	31	876,844	19	1,345,423	16
Utah			9,281	36	43,938	34	148,493	33	263,098	36
Vermont	315,255	10	211,603	23	682,241	20	640,942	25	450,429	29
Virginia	177,137	12	800,650	9	891,231	15	1,609,663	9	2,662,483	9
Washington			20,619	33	71,863	29	127,668	34	999,487	22
West Virginia					848,773	17	934,400	16	2,155,509	11
Wisconsin	4,823	32	78,690	29	819,268	18	639,435	26	267,391	34
Wyoming									1,420	48

*Values are for the crop preceding the census year. The value of orchard products is not given in the census report for 1890.

Table 6.

*Exports of Apples.**

	Fresh.			Dried.		
	Barrels.	Value.	Ave'ge price.	Pounds.	Value.	Average price.
1851	28,842	$71,367	$2.47	.....	.....	.....
1852	18,411	43,635	2.37	.....	.....	.....
1853	45,075	107,283	2.38	.....	.....	.....
1854	15,326	51,766	3.38	.....	.....	.....
1855	33,959	107,643	3.17	.....	.....	.....
1856	74,287	143,884	1.94	.....	.....	.....
1857	33,201	135,280	4.07	.....	.....	.....
1858	27,711	74,303	2.68	.....	.....	.....
1859	32,979	99,803	3.03	.....	.....	.....
1860	78,809	206,055	2.61	.....	.....	.....
Annual average.	38,860	$104,108	$2.68	.....	.....	.....
1861	112,523	$269,363	$2.39	.....	.....	.....
1862	66,767	238,923	3.58	.....	.....	.....
1863	174,502	364,628	2.09	.....	.....	.....
1864	183,969	487,140	2.65	2,841,532	$246,051	$0.087
1865	120,317	481,334	4.00	892,075	105,548	.118
1866	51,612	246,118	4.77	551,350	55,265	.100
1867	29,577	142,023	4.80	510,750	79,922	.156
1868	19,874	94,748	4.77	775,700	121,910	.157
1869	†	†	†	†	†	†
1870	38,157	250,013	6.03	836,110	79,387	.095
Annual average.	88,589	$283,810	$3.20	1,067,920	$114,681	$0.107
1871	49,088	$136,693	$2.78	1,150,122	$79,026	$0.069
1872	36,508	198,948	5.45	2,644,592	190,560	.072
1873	241,663	819,664	3.39	4,483,186	272,028	.061
1874	44,928	204,312	4.55	4,234,736	294,893	.070
1875	276,209	722,247	2.61	4,053,696	326,193	.080
1876	64,472	221,764	3.44	713,840	67,915	.095
1877	417,065	986,112	2.36	14,318,052	920,292	.064
1878	101,617	386,261	3.80	4,188,173	260,085	.062
1879	505,018	980,455	1.94	7,379,836	296,794	.040
1880	407,911	1,190,560	2.92	3,158,367	192,069	.061
Annual average.	214,448	$584,702	$2.73	4,632,460	$289,986	$0.063
1881	1,117,065	$2,301,334	$2.06	22,623,652	$1,247,891	$0.055
1882	176,704	539,543	3.05	2,893,270	228,945	.079
1883	313,921	1,085,230	3.46	10,187,957	786,800	.077
1884	105,400	422,447	4.01	5,558,746	394,350	.071
1885	668,867	1,572,126	2.35	18,416,573	1,062,859	.058
1886	744,539	1,810,606	2.43	10,473,183	548,434	.052
1887	591,868	1,382,872	2.34	8,130,396	413,363	.051
1888	489,570	1,378,801	2.82	11,803,161	812,682	.069

*Bulletin 64, and circular 16, Division of Foreign Markets, U. S. Department of Agriculture.

†Record not kept.

TABLE 6—*Concluded.*

	Fresh.			Dried.		
	Barrels.	Value.	Ave'ge price.	Pounds.	Value.	Average price.
1889	942,406	$2,249,375	$2.39	22,102,579	$1,201,070	$0.054
1890	453,506	1,231,436	2.72	20,861,462	1,038,682	.050
Annual average.	560,385	$1,397,377	$2.49	13,305,098	$773,508	$0.058
1891	135,207	$476,897	$3.53	6,973,168	$409,605	$0.059
1892	938,743	2,407,956	2.57	26,042,063	1,288,102	.049
1893	408,014	1,097,967	2.69	7,966,819	482,085	.061
1894	78,580	242,617	3.09	2,846,645	168,054	.059
1895	818,711	1,954,318	2.39	7,085,946	461,214	.065
1896	360,002	930,289	2.58	26,691,963	1,340,507	.050
1897	1,503,981	2,371,143	1.58	30,775,401	1,340,159	.044
1898	605,390	1,684,717	2.78	31,031,254	1,897,725	.061
1899	380,222	1,210,459	3.18	19,305,739	1,245,733	.065
1900	526,636	1,444,655	2.74	34,964,010	2,247,851	.064
Annual average.	575,549	$1,382,102	$2.40	19,368,301	$1,088,104	$0.056
1901	883,673	$2,058,964	$2.33	28,309,023	$1,510,581	$0.053
1902	459,719	1,628,886	3.54	15,664,468	1,190,593	.076
1903	1,656,129	4,381,801	2.65	39,646,297	2,378,635	.060
1904	2,018,262	5,446,473	2.70	48,301,665	2,791,421	.058

Areas.—There are in Walworth township 1,773¼ acres of orchard made up of areas as large or larger than one acre. This township contains about 34½ square miles. There are, therefore, 51 acres of apples per square mile; or a little over 8 per cent of the land is devoted to orchards. In Ontario township there are about 40 acres per square mile, in Macedon about 19 acres. With the exception of Walworth and probably Marion townships, it may be said that the area devoted to orchards increases as we approach the lake.

The total area devoted to apples in the county is about 21,000 acres. The area of the county is 621 square miles. This gives 33.8 acres of apples per square mile, or 5.3 per cent. The census shows that there are 305,299 acres of improved land in farms. The apple orchards equal 6.9 per cent of this area.

According to the census report for 1899, there were 796,610 "trees of bearing age" in the county. This survey shows the average number per acre to be 41.8. This number of trees would therefore represent an area of about 19,000 acres. Probably 2,000 acres were not of bearing age, or have been set since 1899. This would seem to support

the above estimate, or perhaps the estimate substantiates the census returns, for this work should be much more accurate than the census.

The average area for each proprietor in Walworth is 5.4 acres. This includes all orchards as large as one acre. In the remainder of the county such small orchards were not recorded, so that the average does not give an accurate idea of the average size. The average of those examined was 17.2 acres.

The development of the commercial orchard.—Half a century ago the agriculture of Western New York was grain raising and general farm-

Fig. 40.—*Many of the public roads are lined with apple-trees.*

ing. The orchards were "kitchen orchards." They were planted around the house or in some corner that could not be used for the regular crops. The busy farmer paid little attention to the trees. He merely gathered the apples, and gave about the same attention to the orchard that the boys gave to the chestnut tree. The apples were a clean gift. If there were enough for the kitchen and the cider barrel the farmer was satisfied. He had no quarrel with the worms or the scab fungus. The more worms the more cider apples, and since the farmer sometimes appreciated the cider barrel fully as much as he did the apple barrel, he was willing to share the crop with the insects.

About 1860 men began to plant real commercial orchards. For the first time in the history of the new world, large commercial apple orchards were planted with a view to selling the fruit. It is no wonder that some mistakes were made. The old ideas gained from the kitchen orchard and cider manufacture were naturally carried over into the new industry. Little was really known about the apple-tree. No one knew much about insects and fungi, or how to treat them. Nor did they know how to market fruit. Transportation and markets had to be developed. The poor fruit and low prices discouraged many men. A few even cut down their orchards.

But these years accomplished much. The cheap apples educated the taste of the public and created a demand for more apples. Together, the farmer and Experiment Station man have worked out methods of culture, and have learned how to control the enemies of the apple.

But it takes time for new ideas to become established. The farmer is conservative. It is well that he is so. Because he moves slowly, he moves surely. He never needs to retrace his steps. We cannot expect every one to accept all the new ideas in orchard treatment as soon as they are advanced. It has always required a generation of men to establish any new agricultural system. Changes must largely come through the new generation. Some mature men can readily adapt themselves to new conditions, but it is usually the young man, born under these conditions, who really accepts them.

The many neglected orchards are records of the agriculture of the past, the growing number that are well cared for are the forerunners of the new. In the next fifty years the lake counties of western New York seem destined to become one continuous fruit farm of apples, pears, peaches, cherries, plums and small fruits.

The change from general farming to fruit farming has been very gradual. The decrease in the fertility of the soil and western competition have forced men who were trained in grain farming and who preferred that work to become fruit growers. The grain crops have generally ceased to be profitable when grown for market. This has directed attention to the small apple orchard which has so frequently supported a family when the remainder of the farm gave no profit, or an actual loss. There are many men who still neglect the orchard to care for the field crops when there is not time to take good care of both, but others take the businesslike view and tend to the most profitable crop first.

All through this report the fewer orchards, poorer care, and less yields in the south part of the county are apparent. This difference may be due partly to the more favorable climate near the lake, but this factor is a minor one. The south part of the county has, in general, soils that retain their fertility longer than those in the north part. The grain crops consequently continued profitable for a longer time. The orchards are less profitable because less care is given to them. When equally well cared for they have given as good crops as have those in the north part of the county.

The last few years have seen a rapid improvement in orchard management. Ten years ago there were few cultivated orchards except those in which crops were grown. Orchards were quite commonly considered to be an unprofitable investment. How could they be profitable when not tilled, pruned, fertilized or sprayed? But a gradual improvement has been taking place and has been reflected in the increased profits, until apples are now looked upon as the money-producing crop of the county. Nearly all orchards have received improved care in some respect. It may have been nothing more than a spraying or pruning, or an application of manure when all of these were needed, but the trees have almost invariably responded to any kind of improved care. Fourteen per cent have been distinctly renovated during the past ten years. These have been fairly well cared for in every way.

The canker worm formerly devastated large numbers of orchards year after year. Spraying came into popularity in combating this pest. The canker worm is now almost exterminated, but the many other good effects of spraying have firmly established this practice. Even those orchards which are not sprayed must be greatly benefited, because the men who do spray help to keep the insect enemies of the entire neighborhood in check.

But what has been done in the past ten years in renovating orchards is small in comparison with what remains to be done. The apple-consuming public is constantly demanding a better product. This means that the fruit-grower who can not or will not produce good apples must fall out of the race. Each year a large number of such men is giving place to energetic men who are not satisfied to grow anything but the best. It is these good fruit-growers that will insure the continued supremacy of New York apples.

Picking the crop. The customary method.

CHAPTER II.

TILLAGE.

Acreage of tilled and untilled orchards.—About 30 per cent of the orchards that were set before 1880 were tilled in 1903. This percentage is slightly below what it would have been in a favorable season. The very dry weather in the early spring prevented many from plowing.

About half of the orchards of the county have been in sod five to ten years or more. The other half are tilled more or less. In the south part very few old orchards are tilled,—only 12 per cent in 1903. In the north part tillage is much more common. It is practiced more in Walworth township than in any other part of the county. Here less than one-third of the orchards are in sod permanently (see Table 7 and 8).

TABLE 7.

Treatment prior to 1903. Trees set before 1880.

TREATMENT.	WALWORTH.			REMAINDER OF THE COUNTY.			ENTIRE COUNTY.		
	No. orchards.	Acres.	Per cent.	No. orchards.	Acres.	Per cent.	No. orchards.	Acres.	Per cent.
Tilled 5 years or more..	44	307¾	25	12	219½	15	56	527¼	20
Tilled most years.....	64	242	20	8	208	14	72	450	17
Sod most years, tilled occasionally.....	73	323	27	18	195½	13	91	518½	19
Sod 5 years, or more...	87	335	28	58	852½	58	145	1187½	44

TABLE 8.

Treatment in 1903 of orchards set before 1880.

TREATMENT.	WALWORTH.			SOUTH PART COUNTY.			NOR'H PART COUNTY.			ENTIRE COUNTY.		
	No. orchards.	Acres.	Per cent.	No. orchards.	Acres.	Per cent.	No. orchards.	Acres.	Per cent.	No. orchards.	Acres.	Per cent.
Sod (not pastured)	132	460	30	9	95	23	17	218½	19	158	773½	25
Sod (cattle pasture).....	71	342	22	18	173½	43	14	333	29	103	848½	27
Sod (sheep pasture).....	8	47	3	5	44	11	11	239	21	24	330	11
Sod (hog pasture)	44	151	10	6	46	11	3	27	2	53	224	7
Total sod.....	255	1000	65	38	358½	88	45	817½	71	338	2176	70
Tilled.....	124	538½	35	6	49	12	17	343	30	147	930½	30

Crops were grown in 1903 in about one-third of the tilled orchards. About 8 per cent of the entire area, or 27 per cent of the tilled area, was sown to cover-crops, to be plowed under. The remainder were tilled without any crop, but a cover-crop of weeds was quite common.

Three-fourths of the orchards set since 1879 were tilled in 1903. Crops were grown in all but 7 per cent of those that were tilled. The young orchard generally takes its place as one field in the crop rotation. This keeps it in sod about one-fourth of the time, in small grain one-fourth of the time, and in tilled crops half the years (Table 9).

TABLE 9.

Treatment in 1903 of orchards set since 1879.

TREATMENT.	WALWORTH.			REMAINDER OF THE COUNTY.			ENTIRE COUNTY.		
	No. orchards.	Acres.	Per cent	No. orchards.	Acres.	Per cent.	No. orchards.	Acres.	Per cent.
Sod (not pastured)	13	41	19	4	16½	4	17	57½	9
Sod (pastured)	3	11½	5	4	82	20	7	93½	15
Total sod	16	52½	24	8	98½	24	24	151	24
Tilled	48	163½	76	16	312	76	64	475½	76

Yields of tilled and untilled orchards.—Table 10 gives the yields for four years of orchards that have been tilled every year for at least five years previous to the crop reported, those that were tilled over half the years, those that were tilled occasionally but not half the time, and for those that have been in sod every year for at least five years.

It will be seen that the tilled orchards have given a uniformly larger yield than those in sod, the four-year average of the tilled ones being 80 per cent above that of the untilled. Perhaps the most striking point in the tables is the uniform agreement of the averages for each of the three parts of the county and for each of the four years. It should be remembered that these tables include every orchard set before 1880, for which reports of yields could be obtained, and that every orchard in Walworth was examined. There can be no further question as to whether the average sod or the average tilled orchard in Wayne county gives the larger yield.

TABLE 10.

Yields in bushels of tilled and untilled orchards. Trees planted before 1880.

	Walworth.			South Part of County.			North Part of County.			Entire County.		
	No. orchards	Acres.	Average yield.	No. orchards	Acres.	Average yield.	No. orchards	Acres.	Average yield.	No. orchards	Acres.	Average yield.
1900.												
Tilled 5 years or more	29	145¼	347	.....	.....	.....	6	77½	328	35	222¾	341
Tilled most years	29	94½	388	.....	.....	.....	7	204	273	36	298½	309
Sod most years, tilled occasionally	33	145½	294	6	40	332	4	55½	297	43	241	301
Sod 5 years or more	26	100	264	8	81½	110	17	439	139	51	620½	156
1901.												
Tilled 5 years or more	26	155¼	59	.....	.....	.....	6	77½	126	32	232¾	82
Tilled most years	32	123	79	.....	.....	.....	6	196	69	38	319	73
Sod most years, tilled occasionally	43	190	55	7	47	61	4	55½	55	54	292½	56
Sod 5 years or more	40	181½	45	13	133½	31	16	294	23	69	609	31
1902.												
Tilled 5 years or more	42	303¾	301	.....	.....	.....	11	179½	344	53	483¼	317
Tilled most years	50	220½	265	.....	.....	.....	8	208	295	67	428½	279
Sod most years, tilled occasionally	69	366	227	10	99	211	6	86½	173	85	491½	214
Sod many years	70	295	202	25	221½	181	27	584	160	122	1100½	176
1903.												
Tilled 5 years or more	27	293	335	.....	.....	.....	4	86	291	31	379	325
Tilled most years	20	79½	274	.....	.....	.....	4	45½	222	24	125	255
Sod most years, tilled occasionally	22	118¾	261	4	33½	242	5	73½	199	31	225¾	238
Sod 5 years or more	24	123½	268	11	74	196	8	171	218	43	368½	230

Four-year averages per acre:

Tilled 5 years or more	266 bushels
Tilled most years	229 "
Sod most years, tilled occasionally	202 "
Sod 5 years or more	148 "

A part of this very great difference is doubtless due to other factors. The man who regularly tills his orchard is more likely to fertilize, prune and spray well. To see how much of this difference is due to tillage and how much is due to other factors another classification was made.

Table 11 shows the average yields of those orchards that have been fairly well cared for. They differ only in the factor of tillage. All have received some fertilization, have been fairly well pruned, are not diseased or in bad condition from any cause. Of these well cared for orchards the tilled ones gave an average of 35 per cent above the untilled. This tabulation doubtless gives too high a yield for the

TABLE 11.

Yield in bushels of tilled and sod orchards. Average for the entire county of trees set before 1880. Orchards all well cared for.

TREATMENT.	1900.			1901.		
	No.	Acres.	Average yield.	No.	Acres.	Average yield.
Tilled 5 years or more	25	175¾	348	22	177¼	99
Tilled most years	22	181	353	21	188	38
Sod most years	24	209	260	25	244½	72
Sod 5 years or more	25	206	224	31	249	45

TABLE 11—*Concluded.*

TREATMENT.	1902.			1903.			Four-year average.
	No.	Acres.	Average yield.	No.	Acres.	Average yield.	
Tilled 5 years or more	38	401¾	311	23	345	326	271
Tilled most years	38	261½	339	16	99½	249	245
Sod most years	46	365½	235	15	122	257	206
Sod 5 years or more	47	356½	269	22	157¾	263	200

orchards in sod, for in making it all diseased ones were thrown out. In many cases these should have been included, for the disease frequently gets a foothold because the sod has lowered the vitality of the trees. The real difference due to sod will therefore lie between the 80 per cent shown by Table 10 and the 35 per cent shown by Table 11.

Does tillage pay?—These tables do not show that every sod orchard should be tilled, but they do show that it would pay to till the average

one. If a sod orchard is giving good yields, and if the trees are making sufficient growth to keep up their vitality, it may be desirable to keep it in sod. By the liberal use of barnyard manure or straw mulch, an orchard may be kept in good condition without tillage. The trouble is that so many do not receive enough of either. The same results may be accomplished with much less manure if the orchard is tilled. If the orchard is in sod and is not yielding well, or if the trees are losing their vitality, even if the yield is still good, it will probably pay to till.

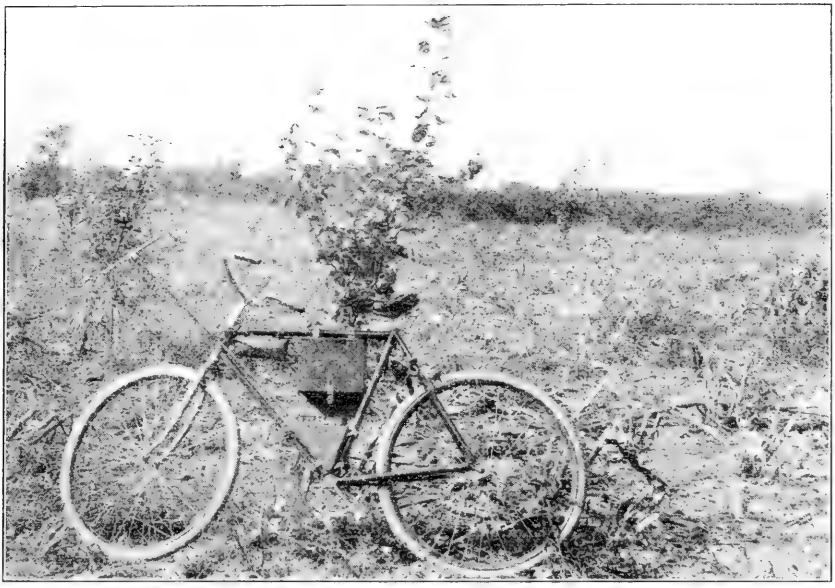

Fig. 41.—*One year's growth in a cornfield. A five-acre orchard planted by Jay E. Allis. Compare with Fig. 42.*

Whatever the best treatment of a thrifty orchard may be, there is no question about the advisability of tilling one that needs renovating or of tilling young trees (see page 309, and Figs. 41, 42, 43).

There are some marked advantages of sod. It requires less work to leave the trees in sod. If the land is very stony, the tillage brings the stones to the surface and makes a bad place for the apples to fall. Sod is also better to haul spray rigs over. Perhaps the greatest advantage is in having a sod for the apples to fall on. This is particularly desirable when the entire crop is to be shaken off for evapo-

rating. Cover-crops will, to some extent, take the place of sod, but it is difficult to get a good cover-crop under large trees. Apples usually color better on sod and are said to keep better, but are not so large. Some experiments are now being conducted on these points.

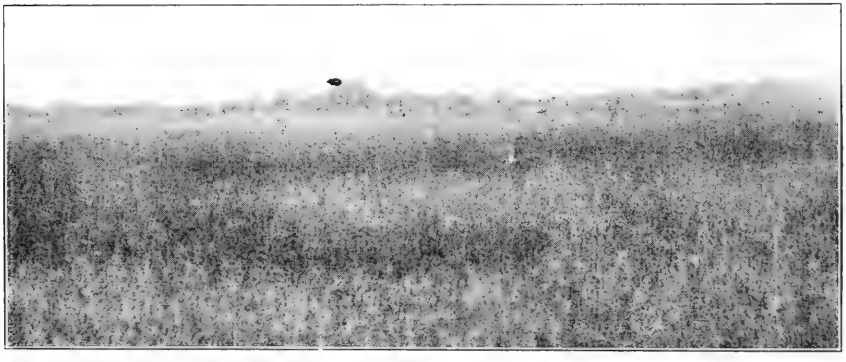

FIG. 42.—*One year's growth when set in timothy sod. A 13-acre orchard in Orleans county. (Compare with Fig. 11.) Here the trees are of secondary importance.*

Tillage, fertilization, pruning and spraying are the chief factors that enter into good care of an orchard. One or more of these may sometimes be omitted without seriously affecting the trees. Tillage may lessen the need for fertilization. Fertilization may help to make up for lack of tillage. Some years few insects or fungi attack the trees, so that spraying is not much needed. Very frequently a grower becomes impressed with the importance of one of these factors and makes a hobby of it to the exclusion of all the others; but the most successful man is the one who keeps a proper balance between all four, and who does not expect spraying to replace manure, tillage or pruning, or vice versa.

FIG. 43.—*A few furrows plowed along each tree row lessen the evil effects of sod. Would it not pay better to raise only tilled crops?*

Where does your orchard come, in the table on page 350? Is it where you want it to be? If so, continue your present methods; if not, then try to find out where the trouble is.

The results of good and bad treatment are not always apparent the first year.—The great difficulty in determining what kind of treatment pays best in any particular orchard is the fact that it may be several years before the results are apparent in the difference in crops. If this fact were kept in mind by the orchardists, a very large part of the differ-

Fig. 44.—*Tillage v. neglect. The rows on the right were left in sod, those on the left were tilled. The trees were otherwise similarly treated, and are of the same age.*

ence of opinion as to the best method of caring for an orchard would disappear. Very frequently a grower has followed a few years of good care by a period of neglect and has received an increased yield as a result. The trees may be making almost no new wood, and may be so lowered in vitality as to be easy victims of canker and other diseases. Yet the increased crop may have persuaded the grower that this is the ideal treatment. *No care can be good if it does not look out for the future of the orchard.* Many orchards need treatment that will actually decrease the yield for several years, while care that will

greatly increase the yield may be destroying the trees or shortening their period of life. *The most profitable crop that could be grown in many orchards is new wood, and consequent new vigor in the trees.* The returns may be more apparent in five or ten years than in the first year or two. Occasionally there is an orchard that is growing too

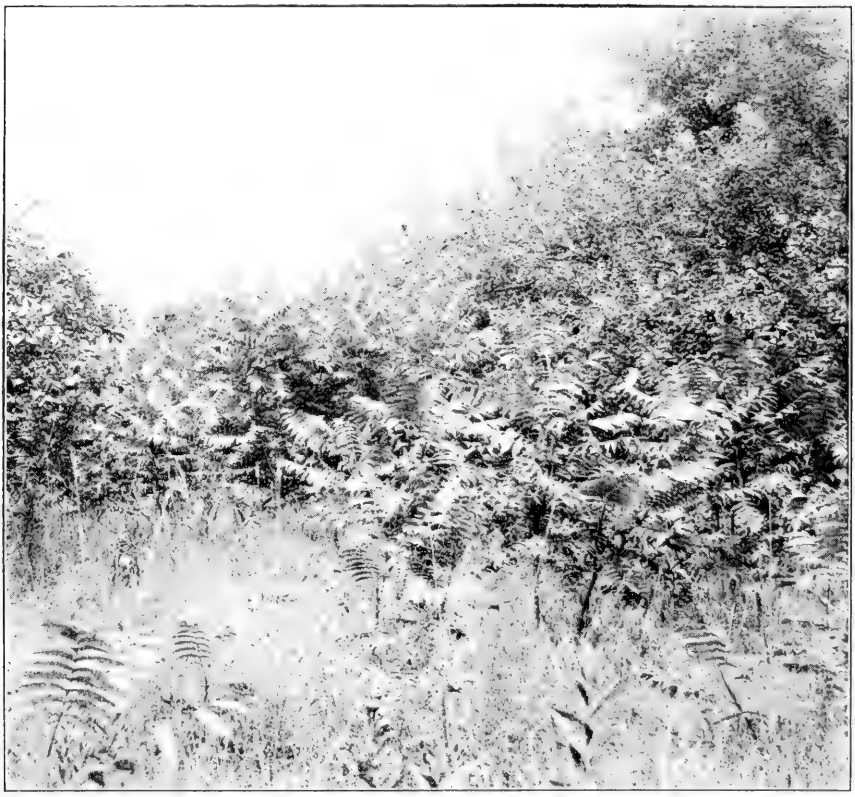

FIG. 45.—*One kind of "culture." This twelve-acre orchard could be renovated and made a good orchard.*

fast and that would be benefited by sod, but they are not common. A much larger number are dying back faster than new wood is being formed.

In Fig. 44 is shown an experiment in orchard management that was carried on by T. G. Yeomans & Sons for many years. The trees on the left were tilled and fertilized. Those on the right were fertilized the same

but were left in timothy sod. The trees in sod are so badly weakened that the land has been plowed and a start made toward renovating them.

Methods of tillage.—Orchards are commonly plowed in the fall. This is frequently done so as to have less spring work. Early spring plowing would seem to be much more desirable for an orchard. The grass or weeds will hold the snow and leaves.

In a few orchards the roots are so near the surface as to prevent plowing. Such an orchard may be tilled with a spading harrow, disk or, on sandy soils, with a spring-tooth harrow.

The ideal system of tillage for most orchards is early plowing or disking, followed by clean tillage until about July 1st. Some kind of a cover-crop is then sown. This cover-crop will produce humus to be plowed under; it furnishes a partial substitute for sod for the apples to fall on; it will help to remove surplus water during the latter part of the season and thus cause the fruit to color better. Fig. 61 and the frontispiece show orchards that are receiving this kind of treatment.

Methods of sod treatment.—Many of the orchards that are in sod are pastured by cattle, hogs, sheep and horses. From some hay is cut; from others the grass is not removed,—usually because there is not enough to pay for cutting. A very few farmers are trying the so-called mulch method of cutting the grass that grows in the orchard and leaving it where it falls or throwing it under the trees. There were not enough of them, nor had the work been continued long enough so that a statistical report could be made.

Table 12 shows the yields for 1902, with the different methods of sod treatment. The number of orchards is not sufficient to give conclusive results. It would appear that pasturing with cattle is the worst possible treatment for an orchard, a conclusion that is in

Table 12.

Yields in bushels for 1902, with various methods of sod treatment. Trees set before 1880.

TREATMENT.	No. orchards.	Acres.	Average yield.
Pastured with hogs	22	105½	271
Pastured with sheep	15	232	216
Pastured with cattle	54	392	159
Sod, not pastured	47	256½	185

FIG. 46.—*A noted sod orchard. This has been in sod fourteen years and has always been an excellent producer.*

accord with the appearance of the orchards thus pastured. Cattle rub on the trees, break the branches and browse the limbs as high as they can reach. The few dollars that it would cost to procure a regular pasture for them is lost many times over by the damage to the trees. Horses are not so frequently pastured in the orchards, but are equally injurious. In one case a good young orchard had nearly every tree stripped of its bark by a span of horses. The orchard was worth about five times as much as the horses.

Next in the scale of injuriousness to pasturing cattle in an orchard is the raising of hay in it. The hay crop grows in the spring at the time when the apple-trees make their growth. It therefore uses the plant-food and water at the time when the trees need it most. If the grass is left on the ground the mulch helps to preserve the moisture, and leaves the plant-food so that the damage is not so great.

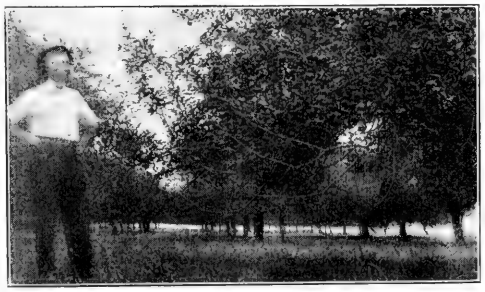

Fig. 47.—*Sheep have removed about a barrel of apples from each tree in this orchard.*

Sheep crop the grass close to the ground, and so to some extent prevent the large evaporation that occurs in a hay field. The manure dropped by them is also of considerable value. Fig. 46 shows an orchard that is pastured by sheep early in the season. This is one of the best sod orchards. Large applications of barnyard manure are used. Several of the limbs that show a lack of foliage are infected by canker. If sheep are allowed to run in the orchard during the latter part of the season, they frequently pick many apples. If prices are good, the apples eaten may be of more value than the sheep (see Fig. 47).

Pasturing with hogs seems to give better yields than any other method of sod treatment. The hogs usually do considerable rooting, and so prevent the formation of a tough sod. In some cases the orchard that has hogs in it might almost be classed as a tilled orchard. The difference is also largely due to the manure. The hogs receive most of their food from outside the orchard, so that there is a constant addition to the plant-food in the soil. Cattle and sheep are usually fed much less.

Hogs frequently do considerable damage to the trees, particularly if the feed-yard is in the orchard. Around the place where they are fed they rub the trunks and roots, pack the soil so as to make it impervious to air, and sometimes bark the trees. It is well to remember that one good apple-tree is worth more than a hog, and that a small strip of bark removed will usually result in a decayed tree. There should always be a feed-yard outside the orchard.

Hogs or sheep do considerable good by eating the apples that fall early, and so disposing of many worms.

None of the methods of sod treatment equal tillage in average yields. A comparison of Table 12 with Table 10 shows the force of this statement.

CHAPTER III.

Fertilization.

Fertilizers used.—The majority of orchards receive no commercial fertilizer or green manure, but are given a limited amount of barnyard manure—usually much too limited. One-third receive no fertilizing of any kind. Sixty per cent receive barnyard manure, either alone or in combination with commercial fertilizer, green manure, etc.; green manure is used alone or in combination in 12 per cent; commercial fertilizer is used alone or with other manures in 13 per cent (see Table 13).

These figures show too high a percentage receiving some kind of fertilizer. In many cases only a little manure was applied, but the orchard was included with those receiving manures. In others the fertilization was given so long ago as to be of no consequence at present. Probably less than half the orchards receive enough to entitle them to be properly included with those receiving fertilization.

Table 13.

Summary of fertilizers used. All ages of orchards included.

Fertilizer.	Used Alone.			Used with Other Fertilizers.			Total.		
	No. orchards.	No. acres.	Per cent.	No. orchards.	No. acres.	Per cent.	No. orchards.	No. acres.	Per cent.
None							154	1101½	33.5
Barnyard manure	214	1453¾	44.3	58	509	15.5	272	1962¾	59.7
Commercial fertilizer	10	103	3.1	40	313	9.5	50	416	12.6
Green manure	14	117½	3.5	17	291½	8.8	31	409	12.3

Orchards receiving no fertilization of any kind.

	No. orchards.	No. acres.	Per cent.
Walworth	117	453	31.4
South part of county	21	241	62.2
North part of county	16	407½	28.1

In many of the fertilized orchards the manure was used with a view to helping some crop planted in the orchard. Of course if it is applied, the apple-trees will make use of a part of it.

Fertilization and yield.—The records of the use of barnyard manure and fertilizers do not cover a long enough period to be used in comparing crops before 1902. The average yields of fertilized orchards for the years 1902 and 1903 were 55 bushels above that of those that were unfertilized (see Table 14).

TABLE 14.

Yield in bushels for 1902 and 1903 for fertilized and unfertilized orchards. Trees set before 1880.

	1902.			1903.			Two-year average.
	No. orchards.	Acres.	Average yield.	No. orchards.	Acres.	Average yield.	
Fertilized	292	2,116¼	233	147	1,210½	281	257
Unfertilized	111	692	173	44	343½	231	202

Necessity for fertilization.—The cultivated orchards demand much less fertilization than the untilled ones, for the tillage makes food that is in the soil available. There are, however, very few soils that do not need some material added at least in the form of green manure.

Many of the less progressive growers fail to recognize the orchard as a crop that requires food as do other crops. A common reply to the question of the kind of manure used was, "We don't raise anything in the orchard so we do not use any manure or fertilizer," the growth of wood, leaves, and apples not being recognized as a drain on the plant-food in the soil. But the number of those who recognize the orchard as a crop requiring food and care is rapidly increasing. The small, light-colored leaves, the very little growth, the small apples, are requests for food. The owner should answer the demand with manure or tillage, usually with both.

The amount of plant-food removed by the apple crop compared with that removed by the wheat crop.—The following tables, based on Bulletin No. 103 of this Station, show something of the demands made by the apple orchard. All the leaves were gathered from a medium-sized, mature apple-tree and were analyzed. The trunk, branches and the roots were also analyzed.*

*Cornell Bulletin 103. October, 1895. This bulletin is now out of print.

TABLE 15.

Plant-food in apple leaves.

	Leaves of one tree analyzed.	Estimated for one acre of 35 trees.
Total weight	232.02 lbs.	
Total weight water	139.51 "	
Total weight dry matter	92.51 "	
Total weight nitrogen	.96 "	33.6 lbs.
Total weight phosphoric acid	.37 "	12.95 "
Total weight potash	1.32 "	46.2 "

TABLE 16.

Plant-food in wood and roots.

	Wood and roots of one tree analyzed.	Estimated for one acre of 35 trees.	Estimated amount removed per year.*
Total weight	5,251.4 lbs.		
Total weight water	2,300.18 "		
Total weight dry matter	2,951.22 "		
Total weight nitrogen	8.09 "	283.15 lbs.	6.29 lbs.
Total weight phosphoric acid	3.07 "	107.45 "	2.39 "
Total weight potash	7.55 "	264.25 "	5.87 "

*To get the estimate of the amount required for wood and roots each year, it was assumed that $\frac{1}{45}$ of the mature tree was grown each year. Trees 45 years old are usually larger than the tree analyzed.

TABLE 17.

Composition of wheat.

	Water.	Nitrogen.	Phosphoric acid.	Potash.
Grain	14.75%	2.36%	0.89%	0.61%
Straw	12.56	.56	.12	.51

Composition of apples.

Water.	Nitrogen.	Phosphoric acid.	Potash.
85.3%	0.13%	0.01%	0.19%

TABLE 18.

Total plant-food removed in one year by wheat and by apples.

	Nitrogen.	Phosphoric acid.	Potash.
300 bushels of apples	19.50 lbs.	1.50 lbs.	28.50
Leaves	33.60 "	12.95 "	46.20
Wood	6.29 "	2.39 "	5.87
Total	59.39 lbs.	16.84 lbs.	80.57
20 bushels of wheat	28.32 lbs.	10.68 lbs.	7.32
2,500 pounds wheat straw	14.00 "	3.00 "	12.75
Total	42.32 lbs.	13.68 lbs.	20.07

According to these estimates it requires, for crops of the size indicated, about four times as much potash, and more nitrogen and phosphoric acid, to grow the apples than is required to grow the wheat. In considering these tables there are several points to keep in mind. The apple roots go deeper into the ground and so have more soil from which to draw their food supply. If the ground has some kind of a crop growing on it, the leaves may be largely retained in the orchard. The amount of plant-food used by the wood is not very well known, as it is difficult to determine what an average growth is. But even the 300 bushels of apples, without any leaves or wood growth, require more potash and nearly half as much nitrogen as is required to produce the wheat and straw.

Manure may be shipped in from the cities.—A few of the more progressive growers have shipped in manure from Buffalo. This costs about $28 per car, but if applied when needed it gives a very large return. Some have feared to use it on account of the danger of getting weed seed. There seems to be no trouble in subduing any weeds that come with it when it is applied to the orchard. There may be some danger of animal diseases being carried in the manure. A much larger total of manure is secured from the many smaller cities and towns, but this is usually not obtainable in very large quantities.

Manure may be profitably secured by the feeding of cattle.—A few growers have fed cattle during the winter in order to secure manure. This enables them to buy their fertilizer in the form of feed. The cattle usually give a fair profit. The manure obtained, added to this, makes

the practice quite profitable. It seems probable that more of this winter feeding will be done in the future. The expense of caring for stock in the winter is not very great. The fertilizing value of the feed is frequently over half of its cost.*

Method of applying manure.—Manure is almost always applied in a small circle around the base of the tree. This is a serious mistake. The roots of a bearing orchard occupy all the ground. Those from one row may extend beyond the next row. The small feeding roots are naturally most numerous at some distance from the tree, much as the active twigs are found at the ends of the large branches. The manure should therefore be applied to the entire ground. If any place is not covered, let it be that near the trunk. Professor Roberts has aptly likened the application around the trunk to putting the hay under the horse's feet.

Cover-crops.—More orchards are in need of humus than are in need of the direct application of plant-food. For this reason the application of barnyard manure generally gives much better results than the use of fertilizers. This is particularly true of sod orchards. Tilled orchards usually do as well when green manure with potash and phosphoric acid are used. On some of the stronger soils no fertilization of any kind may be needed for many years, if plenty of green manure is plowed under.

Eight per cent of the mature orchards of the county were sown to cover-crops in 1902. Buckwheat was the most common, followed by crimson clover and common red clover. Rye, large clover, cow-peas, alfalfa, peas and oats, and vetch were also grown. Buckwheat furnishes a large amount of humus and leaves the soil in a friable condition. It is not a legume, and so can not use nitrogen from the air. Crimson clover has generally done well, but some growers have had difficulty in getting a stand. One man has grown it every other year for fourteen years. Common red clover has been most satisfactory when a year of tillage has been followed by a year in which the clover is cut and left on the land to be plowed under the second year. Peas and oats have given good results in most cases.†

*For tables of the value of the fertilizing elements in various feeds, see Cornell Bulletin 154.

†For a more extended discussion of orchard cover-crops, see Cornell Bulletin 198.

CHAPTER IV.

Pruning.

The former methods of pruning.—Pruning was at first greatly neglected. Just as the majority of orchards were formerly left to fight their way in competition with other plants, so the limbs in each tree were allowed to fight with each other. Only a few orchards have been well pruned from the time of planting. In some pruning was almost entirely neglected for years; in others it was done and is still

Fig. 48.—*Years of neglect followed by too severe pruning.*

done in such a manner as to do more harm than good. There is a tendency among careless farmers to let the trees go for several years and then give them a "thorough trimming" (see Fig. 48), rather than prune some every year, as the careful grower does. Perhaps one-fifth of the orchards are now well pruned, and this number is being added to each year, as the number of real fruit-growers increases. The problem of pruning among the bearing trees of Wayne county is, therefore, not that of training an ideal tree from the time it is planted; but the far more difficult problem of correcting the effects of former neglect.

How wounds heal.—Intelligent pruning is based on a knowledge of the causes of decay, and of the way in which wounds heal.

The living and growing part of a tree is the cambium layer. This is a tissue lying upon the outside of the wood and beneath the bark. From its outside it produces bark, and from its inside it produces wood. It is this layer of young, tender cells that makes the bark "slip" so readily in early summer. The inner part of the tree is not active; its value to the tree is in supporting the living part. If this center part decays, the tree usually continues to grow till it breaks down (see Fig. 52).

This dead inner wood is protected by the bark and living portion so that fungi and bacteria cannot reach it. When a large limb is removed the seal is broken and the dead wood is exposed. Having no life, it cannot resist infection by germs any more than a dead log can do so. The safety of the tree depends on having the wound healed over before it becomes infected. The wound heals by the growth of the cambium layer. If the wound is small it will usually be sealed up before the fungi get established; but if the dead stub is exposed for a long time the wood-rot fungi are almost certain to attack it and cause the trunk to decay. If the wound does then heal over, the mycelium of the fungi is established and may continue to grow within the tree.* The decay may reach into the living tissue, but its most serious effects are in so weakening the trunk as to cause it to break down. In order to avoid the rotten trunks that are so common in the majority of the orchards, three things should be observed:

1. Large limbs should not be removed unless it is absolutely necessary.

2. When such limbs must be removed, the pruning should be so done as to favor rapid healing of the wounds.

3. Large wounds should be protected by paint till the tree can seal them.

The removal of large limbs.—The ideal way would be to have the tree so pruned from the time it is planted that there would never be occasion for the removal of large limbs. But very many orchards were neglected so long that it may be necessary to cut out such limbs. Eighteen per cent of the orchards are still practically unpruned. In a neglected orchard some limbs may be damaged by neglect or lack of food. Others die as a result of the shade caused by dense tops, or the trees being too close together. Even in a well cared for orchard an occasional limb will be broken by the wind, or by too heavy a load of fruit, or will die from other causes. But much of the removal of

*Cornell Bulletin 193, Shade Trees and Timber-Destroying Fungi.

large limbs is done without cause. In the orchard shown in Fig. 48, the trees had too many of these as a result of neglect, but it would have been better to have thinned the tops by the removal of small branches than by cutting out the scaffold limbs. It takes more time to prune by the former method, but the time is well spent. The ultimate death of most trees can be traced to the careless removal of large limbs. The wound is too large to heal, or the cut is made in such a way that it can not heal. Wood-rot fungi get a foothold and soon the tree has a hollow trunk. The wind then breaks off the branches one by one till the tree is gone (see Figs. 52 and 54).

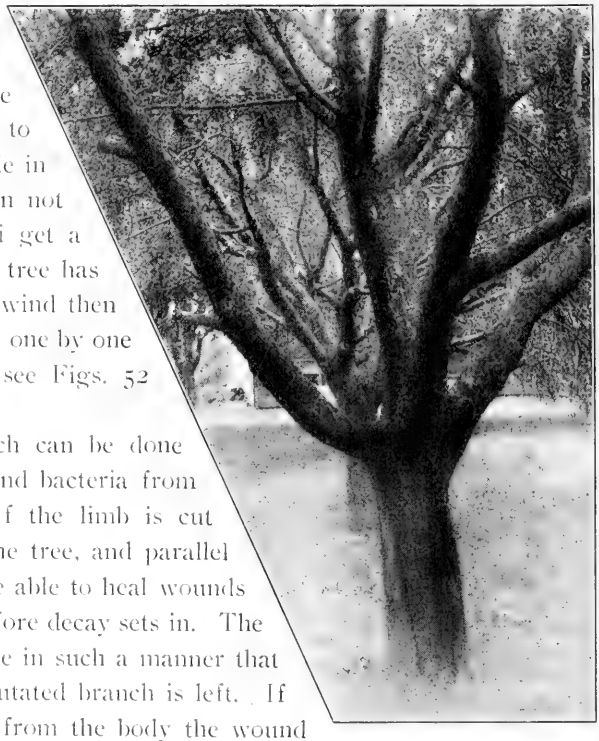

FIG. 49.—*Long stubs left when pruning. These cause the trunks to decay and finally result in broken trees.*

Stub pruning.—Much can be done to prevent the fungi and bacteria from getting a foothold. If the limb is cut close to the body of the tree, and parallel with it, the tree will be able to heal wounds of considerable size before decay sets in. The pruning should be done in such a manner that no portion of the amputated branch is left. If a limb is cut an inch from the body the wound requires much longer to heal than it would if no stub were left. A stub several inches long seldom heals over. It has no life of its own, and so must depend on material that comes from other branches to heal it; but a projecting stub is out of the line of movement of the sap—it is sidetracked. Instead of healing over the end of the stub, a roll of new growth is thrown up around its base where the cut should have been made.

In a little over sixteen per cent of the orchards examined bad stubs were left, varying in length from one or two inches to one foot.

There are two reasons for leaving these long stubs. One, I fear the more common one, is because it is easier to do so. But many farmers leave a long stub when a large limb must be removed because they think that the wound will be too large to heal, and by leaving the long stub they hope to keep the rot away from the tree. The rapidity with which fungi penetrate the wood after they get started refutes this practice. Success must come from preventing the start of decay, not from giving it a long distance to travel before it gets into the trunk. In one forty-acre orchard the owner left stubs about a foot long to serve as ladders! His successor has gone through the orchard and cut these off and has done what was possible to prevent further decay.

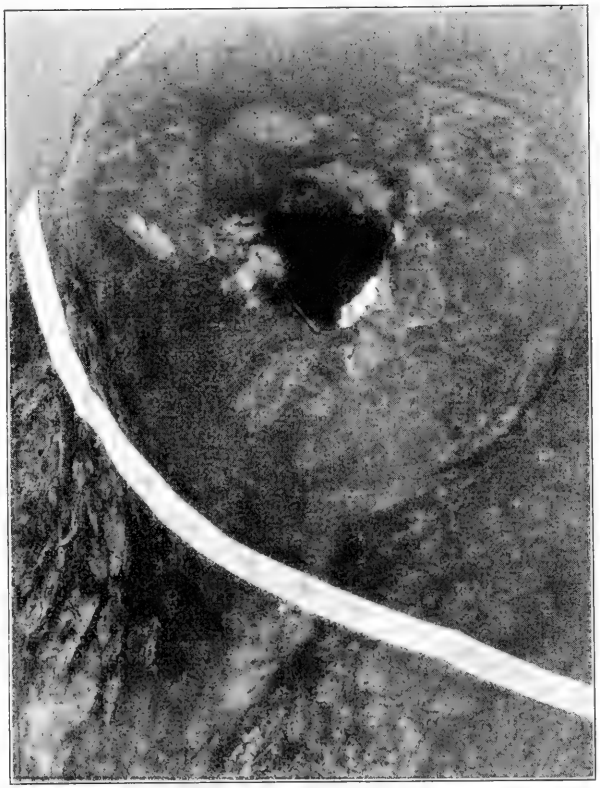

Fig. 50.—*The decayed hole caused by wood-destroying fungi. (See Figs. 51 and 52.)*

In Fig. 49 is shown a tree with long stubs that will result in its death. Fig. 54 gives what will be the next step. The outside of this stub shows the seed-forming bodies (spore fruits) of the fungi; but it does not look very bad, while the inside is so decayed that it only needed a good load of fruit to break the tree. Fig. 53 is another stub that will ultimately cause the death of the tree. The tape-measure shows how far the stick extends into the decayed hole. The decay, of course, goes much farther. Fig. 50 shows a decayed hole that was caused by leaving a large wound

FIG. 51.—*The same tree as Fig. 50, showing the extent of the decay. The tree was about 16 inches in diameter and had only about two inches of sound wood on the outside, a mere shell. The white mould is the mycelium of fungi.*

unpainted. The hole is now nearly closed, but it is too late, as will be seen by Fig. 51, which shows the inside of the same tree. There is only a few inches of undecayed wood on the outside of the trunk. The white mould (mycelium) all through the trunk shows how badly decayed the tree is. The tree was a very thrifty one, and was apparently unaffected, but the rotted trunk was no longer strong enough to support it (Fig. 52).

Paint should be used on the larger wounds.—Only a very few orchards were seen where paint was used. Painting the wounds should become

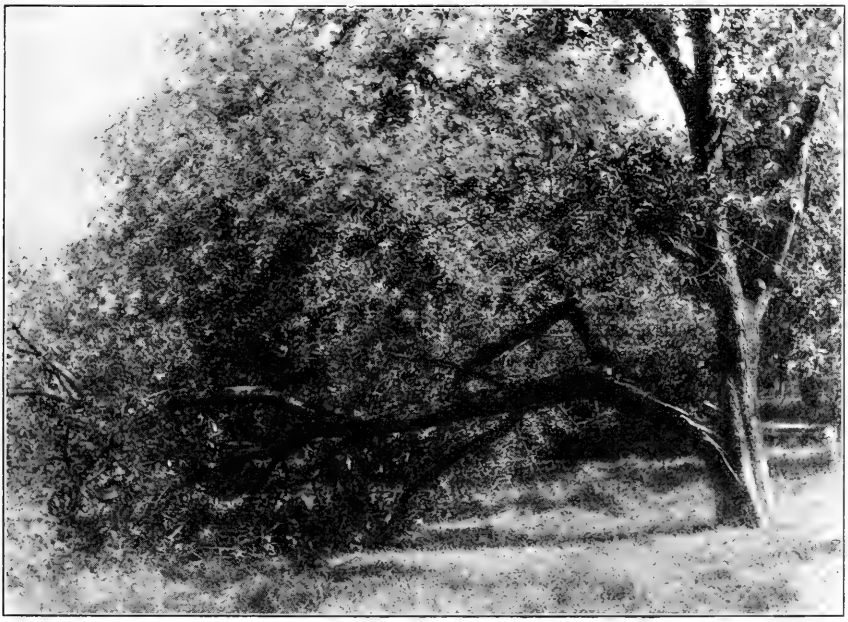

Fig. 52.—*The rotten trunk resulted in the breaking of the tree.* (*See Figs. 50-51.*)

an accepted practice. The paint does not help to heal the wounds, nor does it hinder healing, as some have supposed. It is to prevent the wood-rot fungi from getting a foothold. It acts as a partial seal till the tree can protect the wound in its own way—by healing over the place. It has a similar effect as it has on farm machinery. It protects from weather and prevents fungi and bacteria from causing decay. The cost of painting all the wounds above two inches in diameter is not great. If this is done, and if the larger ones are repainted every year, the increased longevity of the tree will amply repay the cost. One good apple-tree will pay for

painting many wounds. Lead paint is the most satisfactory for this purpose, but any durable paint is probably good.

Thinning the tops.—If the tops are so dense that air can not circulate through them it is almost impossible to spray well. The moisture remains long after every rain or dew, and so favors all kinds of fungous growths. The fruit will be of poor quality and poorly colored. Dense tops favor the development of insects and diseases, but not of apples. The frontispiece shows a well-pruned tree. Notice that the light shines through the top in spite of the fact that there is a large crop of fruit and excellent foliage. Contrast this with Fig. 59. But even this latter orchard is better pruned than the average.

FIG. 53.—*The long stub continued. The tape shows how far the stick extends into the rotten trunk.*

Pruning should vary with the thrift of the trees.—If an orchard is so treated that the leaves are small and the growth very little, many more limbs should be left than in a thrifty orchard. Poor color of the fruit in tilled orchards could be improved to some extent if these trees were pruned more openly. The tree in the frontispiece shows ideal conditions. The air and light can filter through the top and reach every leaf and every apple. If this tree were not tilled or fertilized it could have about double the number of limbs without making the tops any denser. A neglected tree would be a mere skeleton if pruned as this thrifty tree is pruned.

When is the best time to prune?—As a result of a series of experiments in pruning at various times in the year Professor Bailey concludes as

follows: "The conclusion,—and my general opinion,—in respect to the season of pruning, so far as the healing of wounds is concerned, is this: The ideal time is in spring, before growth begins (late February, March and early April in New York;) but more depends on the position of the wound in the tree and

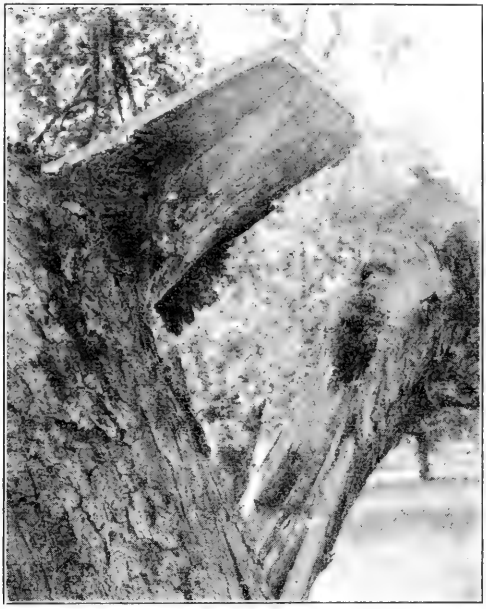

FIG. 54.—*The long stub resulted in the broken tree*

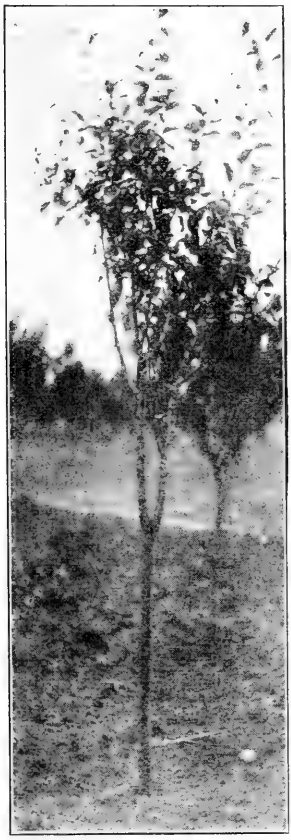

FIG. 55.—*The crotch which will probably cause the tree to split. One of the leaders should be removed.*

the length of the stub than on the time of year."* The best time to prune will generally be the time when labor is least expensive.

How to treat crotches.—The best way to treat a crotch is never to allow one to form; but when one secures an orchard in which they are already formed he must do what is possible to correct the weakness.

In Fig. 55 is shown a young tree with a bad crotch that will be quite certain to ruin it. One of the forks should be cut off. Fig. 56 shows the trunk of an old tree similarly pruned. Fig. 57, from the same orchard as

*The Pruning-Book, fourth edition, 1902.

FIG. 56.—*The result of bad crotches. The tree can be saved for further usefulness by bolting the two halves together.*

Fig. 56, shows two of the split trees and several vacant spaces where broken trees have been removed. Nearly one-fourth of the trees in this seven-acre orchard are already broken down, and as many more are split. There are only a few orchards in the hundreds examined in which the trees were thus systematically pruned to form crotches, but in a large number of orchards a few trees have them.

The split trees and those that are in danger of splitting can yet be saved by the use of bolts. A band put around a tree will girdle it, but a bolt put through it does no appre-

FIG. 57.—*The final result of bad crotches.*

ciable damage. If two bolts that hook into a connecting chain of suitable length are used, the work can be much more easily done. The two holes are then not necessarily in the same line. The chain also allows for variation in length. One bolt is put through one branch, the other is put nearly through the other branch, and the chain is hooked on at the proper length. The bolts are then drawn up. Or bolts with hooks or rings on one end may be used and strong wire used to fasten them together.

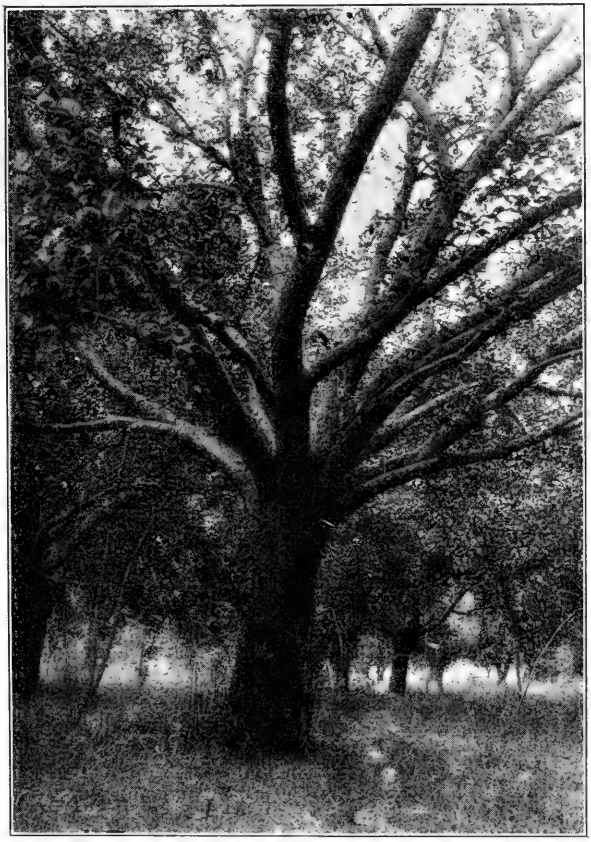

Fig. 58.—*Too many scaffold limbs. Half of these should have been pruned out when the tree was young.*

Number of scaffold limbs.—In Fig. 58 is shown a tree with too many scaffold, or frame work, limbs. The time to avoid this is when the tree is young. Some of the smaller limbs might still be removed with safety if the wounds are kept well painted.

The usual method of sorting in Orleans county—directly from the table.

[illegible] table—a slower but more careful method of sorting.

CHAPTER V.

Spraying.

The extent of the practice.—The fact that so many growers evaporate their entire crop gives rise to a general laxity in spraying. A little over 41 per cent of the trees set before 1880 were sprayed in 1903. One-third are seldom or never sprayed.

In 1902 most buyers of apples for evaporating paid the same price regardless of the scab fungus. This fungus does not seriously damage apples for evaporating unless it is so bad that it stunts or distorts the apple or makes it crack. (See Fig. 81.) In 1902 it was very bad in many orchards. The clean apples were generally considered to be worth more, but were bought at the same price, as one man said, "in order to keep peace in the neighborhood." This puts a premium on neglect and probably accounts for the large number who do not believe in spraying and for the considerable number of those who do spray but do not use the Bordeaux mixture.

Effects of spraying on the yield and price.—The damage from insects and the apple-scab in 1903 was much less than usual. But even in this year of few insects and little fungus, when most people "saw nothing to spray for," spraying paid. The average yield of the sprayed orchards was 27 bushels more than that of the unsprayed. (See table 19). This was probably due chiefly to the prevention of the large loss caused by the bud-moth and to the loss from the codlin-moth. The bud-moth did considerable damage in many orchards, but its work was not commonly seen, or if seen, was attributed to a bad wind that made many leaves turn brown at about the time when the bud-moth caused the young shoots to die. The codlin-moth causes many apples to fall early in the season. A part of the difference may be due to other factors as the sprayed orchards averaged a little better in other treatment.

Table 19.

Yield in bushels in 1903 of sprayed and unsprayed orchards. Trees set before 1880.

	No. of orchards.	No. of acres.	Average yield per acre.
Sprayed	66	626¼	280
Unsprayed	107	673	253

TABLE 20.

Price per barrel of sprayed and unsprayed apples in 1903.

	No. of barrels.	Average price per barrel.
Sprayed	8,430	$2 02
Unsprayed	6,365	1 80

TABLE 21.

Average price per bushel of sprayed and unsprayed apples in 1903.

	No. of bushels.	Average price per bushel.
Sprayed	110,445	$0 31.8
Sprayed, dried by grower	63,145	.....
Unsprayed	96,345	27.7
Unsprayed, dried by grower	64,305	.....

The average price per barrel of the sprayed apples was $2.02; of the unsprayed, $1.80. From the sprayed orchards 15 per cent of the crop was barreled; from the unsprayed, 12 per cent. Without considering the apples that were evaporated by the grower, the average price of sprayed apples was 31.8 cents per bushel; of unsprayed, 27.7 cents.

If we count the apples that were evaporated by the growers as worth 20.7 cents, the average price paid for apples by the evaporators, then the income per acre from sprayed orchards averaged $77.84; from the unsprayed, $63. (See tables 20 and 21.)

Most of the sprayed orchards were sprayed but once. Apples from many of these brought no higher prices than unsprayed ones, but some of those that were well sprayed gave so much better yields and secured so much higher prices that they were able to raise the average as shown above.

The kinds of sprays used.—Nearly one-fifth of the trees that were sprayed received applications of arsenical poison sprays only. The smaller orchards were quite commonly so treated. This one-fifth of the area included one-third of the number of sprayed orchards. In 21 orchards Paris green and water were used without any other materials. (See table 22.) In view of this and of the exceptionally favorable year the showing made by such spraying as was done is satisfactory.

Arsenic is coming to be quite commonly used instead of Paris green, particularly in the larger orchards. It stays in suspension better than Paris green and is somewhat cheaper. Arsenic was used in 58 per cent of the area and in 36 per cent of the number of sprayed orchards.

TABLE 22.

Spraying in 1903. Trees set before 1880.

	WALWORTH.			REMAINDER OF COUNTY.			ENTIRE COUNTY.		
	No. orchards.	No. acres.	Per cent.	No. orchards.	No. acres.	Per cent.	No. orchards.	No. acres.	Per cent.
Sprayed	144	741	50	37	698½	35	181	1439½	41
Sometimes sprayed — not in 1903	126	487¼	33	35	406½	20	161	893¾	26
Seldom or never spray'd	64	257½	18	55	882½	45	119	1140	33
Trees set since 1879.									
Sprayed	18	83	42	3	80	19	21	163	26
Unsprayed	40	112½	58	19	343	81	59	455½	74
Poison used.									
Arsenic	25	170	41	19	458½	69	44	629½	58
Paris green	58	241	59	19	209½	31	77	450½	42
Bordeaux mixture used.									
Poison only	33	122	30	8	74	11	41	196	18
Poison and Bordeaux	50	289	70	30	622	89	80	911	82

Six orchards were sprayed with lime, salt and sulfur for the San José scale. One of these did not have any of the scale within about ten miles, but the owner was afraid it might come. A few young orchards were sprayed with kerosene emulsion for aphids.

Many of the owners of these small orchards have used Bordeaux mixture at some time or other, and because one careless application did not keep the apples entirely free from fungus have concluded that the copper sulfate was of no value. Some even cite the effects of spraying with Paris green and lime as evidence that spraying does not affect the fungus. The failure of Paris green to kill the aphids, which were quite bad in 1903, is also cited to show the futility of spraying. Of course those who conduct apple-growing on a good business basis are not among these.*

*There are three general classes of sprays: 1. Poisons. 2. Sprays that kill insects by contact. 3. Fungicides.

The insects that chew are the only orchard enemies that we can expect to kill with Paris green, arsenic or other poisons of this nature. The lice, San José scale

When is the best time to spray?—The number of sprayings and the time to give them must be determined by the season and the objects for which a man is spraying. But many of the enemies, like the apple-scab, must be treated before they appear. The time of attack by this fungus varies to some extent in different years. (See page 335 for a discussion of the fungus.) In the 564 orchards examined in Orleans county in 1904 it was found that those apples that were not sprayed *immediately* after blossoming were invariably scabby, regardless of the earlier and later sprayings. To keep the fruit in the best condition more sprayings were needed, but this was by far the most important application. If there is much rain during the blossoming period and for two to three weeks following more sprayings will, of course, be necessary than in a dry season. No hard and fast rules can be given, but unless some special enemy threatens the crop the best times will be about as follows:

If three sprayings are given, one just before blossoming, one *immediately* after blossoming, and one from ten to fourteen days later, will generally give the best results. If two are given, omit the first or third. The second and third are the important ones for the codlin-moth. If only one spraying is given it will usually do the most good if applied immediately after blossoming. For the bud-moth and case-bearer a spraying is needed just as the leaf buds begin to open.

Do not expect too much from one spraying. If you give three thorough applications you will, under ordinary conditions, have a right to expect clean fruit.

Some years, as in 1903, good fruit is grown without spraying; but these years can not be foretold. If we wait till the fungus shows, it is too late to spray. The most successful men spray every year. They consider spraying as insurance. They spray even if there is no crop, for they

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and other insects that suck their food, are not hurt by poisons for the very simple reason that they can not eat poison. We would not expect to kill a mosquito by putting poison on the hand and letting him suck the blood from under it—his food, the blood, is not poisoned. These insects feed in a similar manner. They suck the juices from the plant and do not take any material from the surface. They must be killed by kerosene; whale oil soap; lime, salt and sulfur, or by some other spray that kills by contact. Only those which are hit by the spray are killed.

The various fungi are plants. We might call them weeds that have chosen to grow on the apple rather than on the ground. They can not eat Paris green nor are they killed by kerosene and such sprays. For them some fungicide, as Bordeaux mixture, must be used.

consider that good, clean foliage is necessary in order to form the next year's fruit-buds and in order to store up food for the next year's crop.

Winter treatment for apple-scab.—Quite a number of farmers are considering the advisability of spraying for the scab before the buds open. This treatment will not take the place of later applications. If one gives it he should do so with the understanding that it is in addition to the later sprayings, and not a substitute for them.

"When these are made the winter treatment does not bring sufficient additional benefit to justify the additional expense of making it against the scab alone, but it may pay when directed also against the canker disease and combined with some application which must be made against insects such as case-bearers or bud-moth.

"It is known that the scab lives during the winter on the fallen leaves and in the spring produces spores by means of which it spreads to the new foliage. Probably it may exist during winter to some extent on the bark of young twigs also. Granting that this is the case and that a large part of the fungus on the tree is killed by winter treatment, which is improbable, it is evident that when the new foliage appears it must be covered with some fungicide to protect it from the spores produced on the fallen leaves. * * *"*

Method of applying the spray.—In order to do effective spraying there must be plenty of power back of the pump. Good work is sometimes done with hand pumps, but the tops of large trees are not often well sprayed, nor is the work usually as well done with these machines as when power sprayers are used. The power sprayer is rapidly displacing the hand pump.

Many orchardists go through the orchard twice for each spraying—always spraying with the wind. The first time through may be done at the most convenient opportunity. For the second wait till the wind has reversed. Three sprayings therefore require six trips through the orchard. This method secures thorough spraying for each side of the tree.

Russeting of the fruit.—A sound and perfect fruit sometimes shows areas where the skin is reddish brown and rough. This is commonly attributed to too strong a spray. It is frequently caused in that way, but in 1903 and 1904 apples in many unsprayed orchards were russeted. It is caused by any irritation of the skin of the fruit. This is caused by too strong a spray, by late frosts that hurt the skin of the young apple,

*Bulletin 170, New York Agricultural Experiment Station, Geneva, N. Y.

or by anything else that irritates the skin. To prevent injury from the Bordeaux mixture plenty of lime must be used. Four pounds of blue vitriol to fifty gallons of water is sufficient for the later sprayings. This lessens the danger of russeting and seems to be effective in preventing the scab fungus. Six pounds to fifty gallons of water are ordinarily used for the first spraying.

Damage to foliage from spraying.—The foliage is sometimes burnt by too strong a spray. This is particularly likely to occur in rainy weather. However, most of the spots on the leaves that are attributed to the spray are not due to the spray, but to fungi. (See page 340.)

Professor G. W. Cavanaugh gives the following suggestions about spraying in rainy weather:

"In the preparation of Bordeaux mixture, which is made from a solution of blue vitriol and lime, there is a definite chemical union brought about between the copper of the vitriol and the lime. In order that this union may occur, the lime must be in a water-slaked condition, chemically known as calcium hydroxide. Should the lime be air-slaked, i. e. in the form of carbonate of lime, this chemical union with the copper does not take place. The action of the carbonic acid of the air on water-slaked lime is to change the lime to the air-slaked form.

"The chemical union between the lime and the copper in the Bordeaux mixture is not a very stable one. In fact, it is so weak that the carbonic acid of the air can, under certain conditions, break up the union and change even that lime which was combined with the copper into air-slaked lime. This, of necessity, frees the copper and puts it in a condition similar to that where an insufficient amount of lime is used in the orignal mixture. This action of the carbonic acid of the air is facilitated if the mixture remains moist for a considerable time on the foliage. The result of this is a burning of the leaves by the free copper sulfate. When the mixture dries on the trees this action of the gas is so much retarded that no injurious results have ever been noticed. It therefore seems a wise precaution, during a wet season at least, to use more lime than the formula ordinarily calls for."

CHAPTER VI.

Renovating an Apple Orchard in Western New York.

BY CHRISTIAN BUES.

With the increase of our knowledge of the "how" of apple-production comes naturally a greater interest in the apple business. Out of a few apple-trees around the house has grown the commercial orchard. The manager of a large orchard enters the open market. He learns the value of business methods. He looks for opportunities in the business of apple-production. To plant young trees and nurse them into bearing age is a long-term investment. It should be profitable ultimately. But how shall he find an outlet for his energies while his trees are growing; how shall he improve his trade; in short, where is the immediate opportunity for business?

There are thousands of acres of apple orchards of bearing age in Western New York which are not giving the revenue that they ought to give. Many of these can be bought at a reasonable price. If the trees are in a fairly good state of health the renovation of such orchards may be profitable. We have heard a great deal during the last few years about this feature of fruit-raising. What are the actual facts? A concrete example will illustrate better than any amount of theory.

In 1896 Mr. George Pettit bought a "run down" farm at Kenyonville, Orleans county, N. Y. The farm was neglected. Therefore the price paid was not high. Fifty-four acres were bought for $2,200. On the farm was an apple orchard of eleven acres, two acres of which had been drowned out, literally killed by standing water, when an outlet could be found not more than fifty yards away into the steep gorge of Oak Orchard creek. This left nine acres of orchard with which to work. The trees had been planted in the spring of 1864, i. e. they were thirty-two years old and should have been just entering into their prime of production.

The soil on which this orchard stands is Miami silt loam. (See page 317.) On the remaining nine acres the drainage was not perfect. Because of lack of care the trees were older than their actual age would indicate. Pruning and feeding had been sadly neglected, and canker was rapidly unfitting many limbs for the bearing of a crop. Mr. Pettit tells me that it was in about as bad a state as regards care as it could possibly be.

The problem of renovation was undertaken with vigor. The water was drained off, the land was plowed, and thus the soil brought into such a condition that the plant-food would be available. The trees were freed of dead wood, the worst canker-diseased limbs removed, and the whole was disinfected by the liberal use of Bordeaux mixture and arsenic. Plant-food was supplied to produce the most essential crop—new wood. The following tabulates the cultural method:

1896. Orchard was in sod; the grass was mowed.
1897. Orchard was plowed and beans were grown.
1898. Orchard was manured and beans grown again, followed by crimson clover.
1899. Orchard was manured and crimson clover plowed under.
1900–1904. Orchard has been manured every year and buckwheat is grown, to be rolled down toward ripening time of the fruit.

During the last three years every tree in the orchard received each year one-quarter of a load of manure, to which was added in 1904 for each tree 12 pounds of a good commercial fertilizer containing 8 per cent potash and 10 per cent phosphoric acid.

Spraying has always been faithfully done, crop or no crop; for Mr. Pettit knows that he must have a healthy vigorous tree before he can obtain a profitable crop. Here is the spraying program of the season of 1904:

First spray: When blossom buds began to swell.
Second spray: As soon as the blossoms dropped.
Third spray: About two weeks after second spray.
Fourth spray: A partial spray July 25. This had no apparent effect.

The spray used was Bordeaux mixture and Paris green, slightly decreasing the amount of blue vitriol with each successive spraying.

This orchard may well be called a "rejuvenated" orchard, for hardly any of the old tree-tops exist now. The Kings, Greenings and Russets have grown entirely new tops in the course of the eight years during which Mr. Pettit has handled the trees, and the Baldwins are doing so, although at a slower rate. I remember one particular Spitzenburg tree which tells the story of many hardships. By continued spraying and generous feeding the many old cankers are nearly overgrown by new wood, and a new top has been produced which looks vigorous and healthy and ready to do business for many years to come.

Now if we want to renovate orchards for business, how does the account of this orchard balance? Is it worth while to borrow money in order to invest it in orchard renovation? Mr. Pettit kindly placed at my

disposal an itemized account for the season of 1904. The price charged for team and machinery is large enough to allow for "wear and tear." To the debit should be added interest on capital invested. Every hour of work done in the orchard by the proprietor or by his men has been charged to it.

Apple orchard.

1904.		Debit.
June	To 8 days' hauling and spreading manure, at $1.50	$12 00
	To 3 days' teams for hauling, at $2	6 00
	To 80 loads of manure, at $1.50	120 00
	To 1½ tons commercial fertilizer, at $20	30 00
	To 2 days' pruning, at $2	4 00
	To 3 days' hauling brush	5 00
	To 6 days' work, spraying, 3 men and team, at $7	42 00
	To 1 day dragging with 3 horses	4 00
	To 1 day dragging with 2 horses	3 00
	To 2 days' spreading fertilizers	4 00
	To 1 day dragging with 3 horses	4 00
	To 1 day hoeing around trees	1 50
	To 1 day with team	3 00
	To 1 day cleaning out ditches	1 50
	To 1½ days' cultivating, at $4	6 00
June 20.	To 3½ days' spraying, at $7	24 50
	To 1 day getting material	3 00
	To 30 lbs. Paris green, at 18c	5 40
	To 400 lbs. blue vitriol, at 5¾c	23 00
	To 4 barrels of lime, at $1.25	5 00
	To 1 pair of pruning shears	2 00
July 6.	To 1 day of dragging	3 00
	To ½ day sowing buckwheat	1 00
25.	To spraying 3 hours, at 70c	2 10
	To spraying mixture	70
	To 7 bushels buckwheat seed, at 75c	5 25
Aug. 13.	To 4 hours' breaking buckwheat	1 60
16.	To dragging down buckwheat, 1 horse	2 00
17.	To dragging down buckwheat, 1 horse	2 00
18.	To propping trees, 2 men and team	3 00
27.	To propping trees, 2 men 2½ days	10 00
	To 1,840 empty barrels, at 36c	662 40
	To harvesting 1,840 barrels of fruit and hauling to the railroad, at 25c	460 00
	Balance	*1,260 55*
		$2,722 50

Apple orchard.

1904.	Credit.
By 1,765 barrels of apples, No. 1, at $1.50	$2,647 50
By 75 barrels of apples, No. 2, at $1	75 00
	$2,722 50

Thus our account for this year gives a net profit above expenses of $1,260.55. To do justice to the orchard it is fair to state that at the date

when the figures were received there remained about 1,300 bushels of apples in the orchard which might have been sold as evaporating stock had not the evaporators been filled to their utmost capacity.

How do the crops taken from the orchard compare with the original investment? It is not possible to give these figures net, as an itemized expense account is not available. The gross returns from the orchard are:

1896	$250 00
1897	12 00
1898	800 00
1899	200 00
1900	1,200 00
1901	300 00
1902	2,000 00
1903	1,400 00
1904	2,722 50

It will be seen that there is a gradual general increase in the amount of the crop. Naturally there exists a corresponding increase in the cost of production and marketing.

In a considerable percentage of New York orchards the renovating process has begun. It can not be done according to a fixed schedule. Conditions in one orchard are not often the same as in another. However, the experiences of other men and close observation will soon lead one in the right direction. Two things are most needed. The first is the consideration of the orchard as a business proposition, with which we enter into an account and from which we want to exact a fair profit. We may have to wait a few years for the returns, but we must look for ultimate profits. The usual experience is that vigorously renovated orchards begin to give fair returns in about three years, but this depends on the condition of the trees and the manner of treatment. The second important factor is: the man who takes charge of the orchard should know and love an apple-tree. He should be able to put himself into its position and to realize the various influences which this or that line of treatment would have upon a living organism. Only then can he understand such things as why a soil needs draining and why parasites should be kept off. It is not so much any particular kind of soil that produces the apple, or any special brand of fertilizer, or any individual spraying mixture. The essential thing is the crop of thought raised in the well-cultivated mind of a nature-loving man.

CHAPTER VII.

Number of Trees Per Acre and Distance Between Trees.

The trees are planted too close together.—One of the greatest enemies of the apple orchard in Wayne county, as in most other apple-growing regions, is the apple-tree. When the greater part of the orchards were planted, about forty years ago, there was a universal tendency to plant too closely. On 43 per cent of the area planted before 1880 the trees are 30 x 30 feet or less; 82 per cent are 35 x 35 feet or less. Only 18 per cent are over 35 x 35 feet; and a part of these were planted more closely but have been thinned. (See table 23.)

Table 23.

Distance between trees.

Distance apart.	Planted before 1880.				Planted since 1879.			
	Average no. trees per acre.	No. orchards.	No. acres.	Per cent.	Average no. trees per acre.	No. orchards.	No. acres.	Per cent
Not over 25x25 ft.	82	55	151½	5	70	3	4	1
26x26 to 30x30	52	198	1165¾	38	51	27	118½	18
31x31 to 35x35	38	143	1195	39	37	24	148½	22
36x36 to 40x40	27	73	534½	18	27	31	328	50
41x41 to 50x50					19	6	61	9

	Planted before 1880.	Planted since 1879.	All ages.
Average number of trees per acre	43.6	33.2	41.8
Average distance apart	31.6	36.2	32.3

A comparison with the recent plantings shows that many growers have learned not to plant so closely. Nearly two-thirds of the area set since 1879 has the trees 35 x 35 feet or over, the average distance being 36.2 feet or 33.2 trees per acre, as compared with a distance of 31.6 feet and 43.6 trees for the older orchards. Some growers have not yet learned the lesson, and need to have their attention called to it. Forty by forty feet is close enough for nearly all varieties. The Duchess, Wealthy and a few other varieties might perhaps be planted a little closer. Mature Baldwin and Greening trees should be at least 40 x 40 feet apart.

About one-fourth of the orchards in Walworth township were planted on the quincunx system with the rows 20 feet apart and the trees 40 feet apart in the row. This makes the trees in squares 28.4 x 28.4 feet, cornerwise of the field. Some nurserymen recommended this system with the idea of removing every other row, so as to leave the trees 40 x 40 feet. A few growers did this before much damage had been done by crowding, and may have secured enough fruit from the extra trees to pay for the increased labor which these trees necessitated.

Outside of Walworth this system was much less used, but the trees averaged almost the same distance apart. Rather than blame the nurserymen who recommended the thinning system, as some have done, we should give them credit for being better informed than most persons of that time, for they recognized that mature trees would need to be 40 x 40 feet. Other persons planted equally close without having any idea that a part would need to be cut out.

This system may be all right if carried out, but it is certainly not to be recommended to the general public. Few people have the courage to cut down good, thrifty trees. If they do thin them it is usually not done until the trees have been greatly damaged—all the lower limbs killed. It will be better for most persons to leave out half the trees and raise crops in the orchard for a few more years, or plant some short-lived fruit like peach-trees, that will die before the apple-trees need the room.

Effect of close planting on yield and health.—The more trees per acre the less the yield. The average yield for four years of orchards where the trees are not over 30 x 30 feet apart is 186 bushels; for those over 30 x 30 feet but not over 35 x 35 feet, 222 bushels; for those over 35 x 35 feet, 229 bushels. (See table 24.)

The question is still more important than these figures indicate. In many orchards the trees are being ruined because they are so close together. In Orleans county more growers have removed half the trees, but few in Wayne county have yet done so, and more attention needs to be given to the question. Farmers usually fail to notice what is happening until the trees have been greatly damaged. The decrease in yield does not call attention to the trouble till it is too late. When the tops begin to meet so as to shut out the light from the lower limbs it is time to cut out half the trees. (See Fig. 59.) If this is not done the lower limbs first bear inferior fruit, then no fruit, and finally die. The changes take place so gradually that the owner usually fails to realize what is

TABLE 24.

Distance apart and yield in bushels. Trees set before 1880.

DISTANCE APART.	WALWORTH.			REMAINDER OF COUNTY.			ENTIRE COUNTY.		
	No. orchards.	Acres.	Average yield.	No. orchards.	Acres.	Average yield.	No. orchards.	Acres.	Average yield.
1900.									
Not over 30x30 feet ...	78	285¼	282	22	305½	231	100	590¾	256
31x31 to 35x35 feet....	32	140½	389	18	217½	264	50	358	314
36x36 to 40x40 feet.....	18	93	332	6	80½	224	24	173½	282
1901.									
Not over 30x30 feet....	83	310¼	38	23	334½	30	106	644¾	34
31x31 to 35x35 feet	41	206	60	21	255½	83	62	461	75
36x36 to 40x40 feet	33	192	92	8	100½	81	41	292½	88
1902.									
Not over 30x30 feet....	154	556¼	229	44	604½	212	198	1160¾	220
31x31 to 35x35 feet	77	380½	249	34	682½	212	111	1063	226
36x36 to 40x40 feet	50	338½	256	11	115½	220	61	454	249
1903.									
Not over 30x30 feet....	65	274¼	252	23	342½	215	88	616¾	232
31x31 to 35x35 feet	29	137	309	12	112½	224	51	249½	271
36x36 to 40x40 feet	27	254½	302	5	74½	281	32	329	296

Four-year average:

Not over 30 × 30 feet..... 186 bushels
31 × 31 to 35 × 35 feet..... 222 "
36 × 36 to 40 × 40 feet..... 229 "

It might seem that the closer plantings would include many old trees, but the change in the distance apart has been made largely since 1880.

happening till some year he finds that instead of an orchard of well-rounded apple-trees he has a lot of forest trees with a bouquet of leaves at the top.

In the end the bearing surface becomes the nearly level surface on the tops of the trees. This is a very small surface when compared with a succession of well-rounded tops. (See frontispiece.) If trees are 30 x 30 feet and are left till they interfere so as to kill the lower limbs, the bearing surface approaches the level surface on the top of the trees. Each tree approaches 900 square feet of exposure to sunlight, or bearing surface; or two trees approach 1,800 square feet. This is what was done in the orchard shown in Fig. 60. The owner of this orchard started to cut out half the trees about ten years ago. He cut down one tree, but it seemed to make such a big hole that he decided to prune them instead. The

FIG. 59.—*Beginning to crowd. When the tops begin to meet so as to shut off the sunlight from the lower branches it is time to cut out some of the trees.*

figure shows the result. Suppose half of the trees had been cut out at the proper time, they would then be 42.4 x 42.4 feet. This was done by Mr. Albert Woods in the orchard shown in Fig. 61. These trees average about 32 feet high and have a spread of about 40 feet. The area of the surface of a well-rounded tree 32 feet high and having a spread of 40 feet is about 4,000 square feet. Trees of this size still lack 2.4 feet of meeting, and 30 per cent of the surface of the ground is exposed to light—none too much. In other words they are a reasonable distance apart, but the one tree has at least twice as much bearing surface as the two trees in the former orchard. This calculation assumes the tree to have a regular form and is, of course, hypothetical, but it clearly indicates that there are two reasons why trees that are planted too closely do not bear as much as do those that have more room: (1) They are not as healthy. (2) They do not have as much bearing surface.

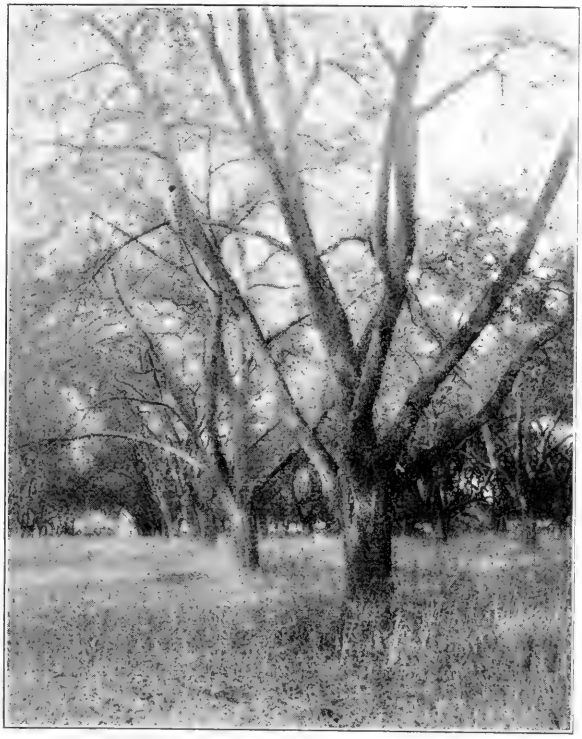

Fig. 60.—*A poor system of pruning. The best bearing wood removed and the trees almost ruined rather than cut out half of them. (Compare with Fig. 61.)*

Trees that are too close together furnish favorable conditions for fungi and insects; they are hard to spray; the apples are more difficult to pick and are of poorer color and quality. Probably the most serious result is an indirect effect of the death of the lower limbs. Trees are left until the large lower limbs die for want of light. These are then removed and the wounds are too large to heal. In time they cause the trunk to decay. (See Fig. 62.)

FIG. 61.—*Half of the trees were removed fourteen years ago. They are a convenient distance for working between and give an opportunity for sunshine to reach part of the ground. (Compare with Fig. 60.)*

Top-grafting or pruning every other row.—Some men have top-grafted half of the trees a few years before cutting them out. Most of those who have tried this would not do so again. It is some expense to do the grafting, and by the time the grafts are ready to bear well it is about time to cut the trees down. Some have cut back the tops of the trees to be removed, leaving the center part to bear a few years before removing the tree. This seems to have paid in some cases, but has not always been satisfactory. Too much must not be expected of any such devices, for they do not relieve the condition under ground. The roots interfere before the tops do. When the tops begin to interfere it is high time to remove half the trees.

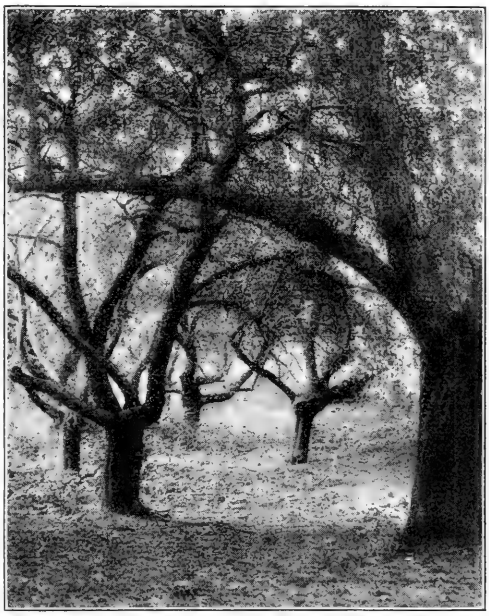

Fig. 62.—*The large lower branches die because the trees are too close. The limbs are then removed, and the next stage is a decayed trunk. Notice the holes in the second tree on the left.*

How to thin.—If the trees are planted in squares the best way to thin is to cut out every other tree in each row. This is done by cutting out every other row diagonally. It leaves the trees in squares cornerwise of the field. (See Fig. 63.)

It is interesting to note what removing half the trees would mean. Persons sometimes think that doing so in an orchard that is 25 x 25 feet would leave the remainder 50 x 50 feet. As a matter of fact they would be in squares of 35.3 x 35.3 feet, when viewed from the corners of the field; if 30 x 30 feet, and half removed, the remainder would stand 42.4 x 42.4 feet; if 33 x 33 feet, and half removed, they would be 46.7 x 46.7 feet. None of these distances is too great for large, mature trees. If 35 x 35 feet, and half removed, they would be 49.5 x 49.5 feet. Large Baldwin trees can make good use of this much room.

One of the problems to be met in thinning is that, if every other tree is removed regularly, there will be some places where the tree to be cut out

is better than the one to be left; or it may occur that the one which should be left is missing. Will it pay to leave a tree that would otherwise be removed if it comes next to a vacant place? This question must be

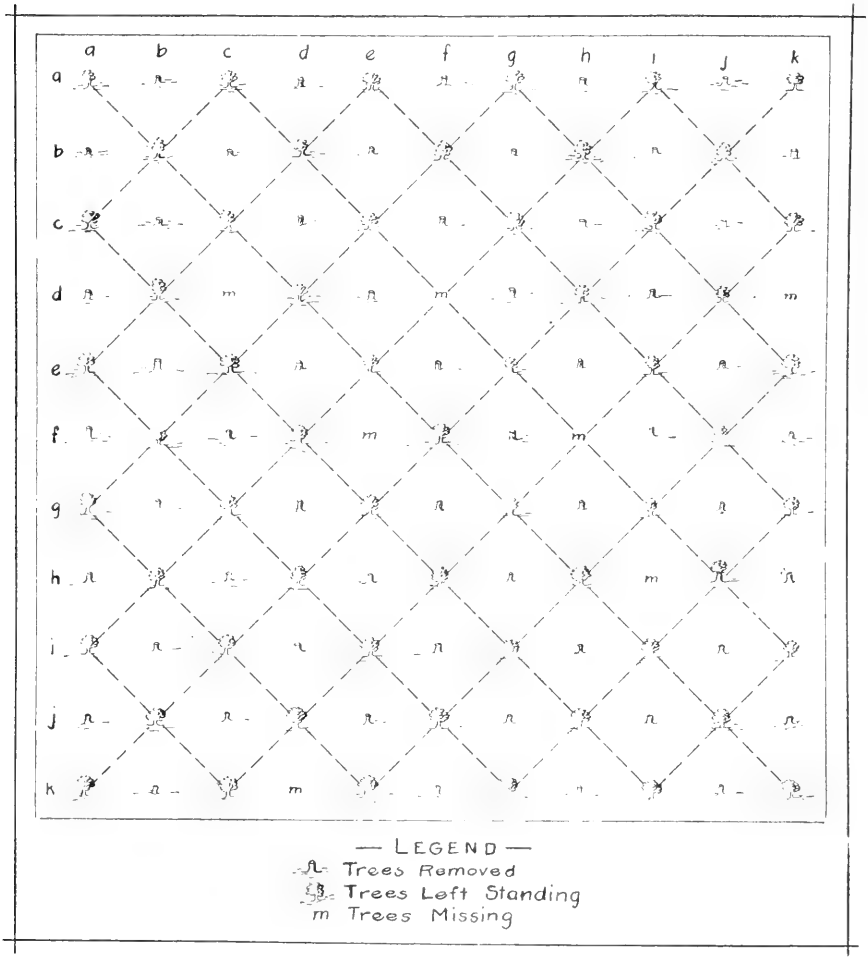

FIG. 63.—*Diagram showing half the trees removed. The dotted lines show that the trees remaining are in squares cornerwise of the field.*

answered as each case arises, but it is well to remember that if the tree is left it will damage one side of three other trees.

Before cutting out the trees it will pay to make a map of the orchard and locate the vacant spaces and poor trees, and so determine which way of cutting will include the greatest number of these. In Fig. 63 the rows

bb, dd, ff, etc., or the rows *cc, ee, gg,* etc., may be removed. Sometimes it will make a difference of several trees which is done. Suppose that the trees marked *m* are poor trees or missing; then by removing rows *bb, dd,* etc., five of these will be included. If the other set of rows are removed only two will be included, a gain of three trees by the former method—enough to much more than pay for the trouble of making the map.

It requires courage to go into a fine apple orchard, one that has been watched over for years, and cut out good, healthy trees. But in many orchards the time has come when a choice must be made between two poor trees or one good one. If one has definitely made up his mind that his trees are crowding, perhaps the best way to thin them is to do as the owner of a fine Baldwin orchard of twenty acres did. He decided which rows should be removed. Then, to be sure that he would not repent and have some of the trees left, he went away on a two weeks' visit while the boys did the work.

CHAPTER VIII.

Age of the Orchards.

Date of planting.—Few of the old orchards are now owned by the men who set them, or even by the descendants of these men. It is, therefore, difficult to get the exact age in all cases, but the reports are probably accurate enough to give reliable conclusions.

Most of the trees set before 1850 were for the purpose of supplying the family wants. About this time growers began to set commercial orchards. The majority were set between 1860 and 1875. The number planted decreased till 1895. Since then there has been a gradual increase. (See table 25.)

The young orchards are nearly all in the north part of the county. Very few trees have been set in the south part during the last twenty-five years. (Some discussion of the reason for this will be found on page 259.)

Table 25.

Number of acres planted during each five-year period. The table includes only those orchards that are still living. Some of the earlier plantings have disappeared.

Date of planting.	No. of orchards	No. of acres.	Per cent.
Before 1840	18	73	2
1840–49 (10 years)	33	167½	4½
1850–54	42	167	4½
1855–59	45	298½	8
1860–64	153	810¼	22
1865–69	91	717	19
1870–74	67	450	12
1875–79	43	380½	10
1880–84	22	194	5
1885–89	12	71½	2
1890–94	19	54	1½
1895–1903 (8 years)	47	377	10

Yield at different ages.—The fact that apples are the chief source of income for so many farmers, and that practically every one considers them to be a paying crop, would seem to raise the question of why more orchards are not planted. The great deterrent to such planting is the long time that one must wait for returns. With the usual treatment of

Baldwin and Greening trees they do not begin to be profitable for nearly twenty years. A much less profitable crop that gives returns the first year can therefore compete with apples.

If well cared for, the trees will usually pay sooner. But the very fact that it is so long before a revenue is secured causes the owner to neglect the trees, so that the normal period is increased. The young orchard usually takes its place as a field in the crop rotation, and is therefore in sod or small grain half the time. One frequently sees young orchards in wheat-fields or hay-fields. "The short growth, knotty bodies and yellow leaves tell the story of shallow roots, dry soil, borers, and all the ills which every farmer who follows such methods deserves to have

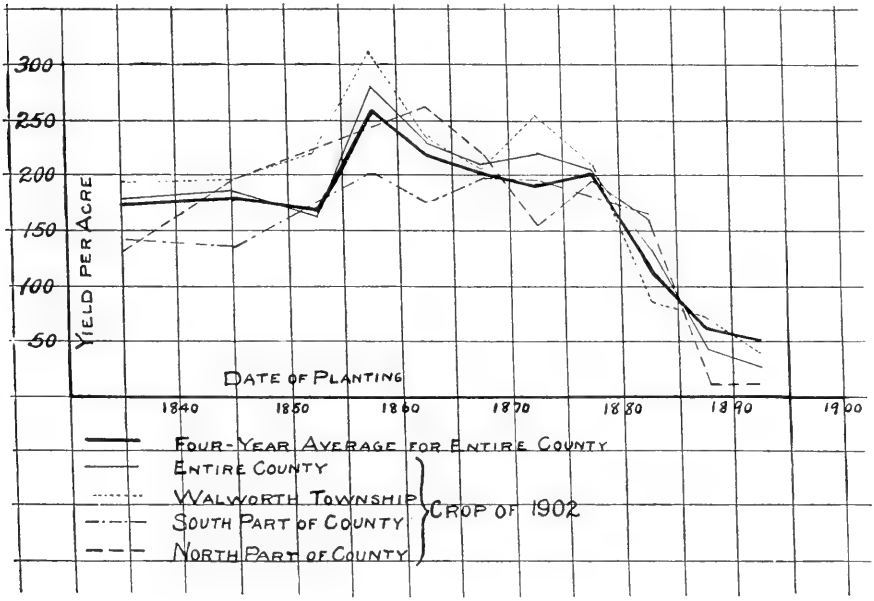

FIG. 64.—*Diagram showing the yield in bushels at different ages.*

fastened to his trees."* Grain and hay should never be grown in a young orchard. The first thing to grow is an apple-tree. Tilled crops are the only ones that can be grown without damaging the trees and lengthening the period before they are ready to bear. (See Figs. 41, 42 and 43.)

Many of the orchards now being set are composed of Ben Davis, Hubbardston, Duchess and other early-bearing varieties, but Baldwin and Greening still hold a place.

*Cornell Bulletin 72.

It is a long time to wait for Baldwins and Greenings to begin to bear, but they make up for this delay by continuing to be profitable for many years. The life of an apple-tree has commonly been spoken of as about forty to fifty years, but the maximum yield in Wayne county is not reached till forty-four years from the time of planting. (See table 26 and Fig. 64.) After this there is a gradual decrease. Several orchards set before 1820 are still profitable. With the better care that trees are now receiving, their age of maximum yield will doubtless be increased. It is probable that the returns for good treatment will be even more marked in prolonging the life of the orchard than in increasing the annual yield. (See Fig. 65.) There are very few 45-year-old trees that have not seen some very rough treatment. They have gone a number of years without any fertilization or tillage. The canker-worm has feasted on them; cattle have damaged them. They have gone years without pruning, or, worse, have had large limbs cut off in such a way that the wounds can not heal. Some orchards of this age are composed of sound, thrifty trees that give promise of an increased yield for some years to come.

FIG. 65.—*Ninety-six years old and still young. This orchard contains about 115 of the original 270 trees set 96 years ago. Orchard of J. A. Kuck, Kuckville, Orleans county.*

Will it pay to plant young orchards?—From the ages at which the yields begin to decrease it would seem that in about twenty years a large

part of the present orchards would cease to be profitable. It must be remembered that table 26 includes only those orchards that have survived. Many orchards set sixty-five years ago have entirely disappeared.

TABLE 26.

Age and yield per acre in bushels.

DATE OF PLANTING.	1900.			1901.		
	No. orchards.	No. acres.	Yield.	No. orchards.	No. acres.	Yield.
Before 1840	4	10	215	7	24½	83
1840–49	1	10	200	6	37	38
1850–54	12	43	245	13	47	34
1855–59	9	33	368	17	84¾	67
1860–64	54	278¾	347	63	360½	57
1865–69	41	366	293	44	465	55
1870–74	26	238	219	34	278½	61
1875–79	12	81½	255	15	101	64
1880–84	9	67	164	9	69	6
1885–89	1	5	80	1	5	0
1890–95	4	18	50	4	14	36

TABLE 26—*Concluded.*

DATE OF PLANTING.	1902.			1903.			FOUR-YEAR AVERAGE.	
	No. orchards.	No. acres.	Yield.	No. orchards.	No. acres.	Yield.	Average age.	Yield
Before 1840	14	60	175	1	1½	210	64	171
1840–49	17	93½	186	3	18	267	59	173
1850–54	38	154	220	13	48¾	224	49	181
1855–59	34	255½	281	12	161½	312	44	257
1860–64	115	612¾	232	54	284½	236	30	218
1865–69	74	652	212	25	274¾	238	34	200
1870–74	51	380½	222	23	211½	261	29	191
1875–79	25	138½	204	11	45¾	286	24	202
1880–84	9	120	133	7	47½	155	19	115
1885–89	6	26	42	1	10	140	14	66
1890–95	10	21½	29	1	10	100	9	54

The tabulation for each division of the county gives the maximum yield at this same age—44 years.

It is difficult to tell just how much effect the better care will have in prolonging the life of the trees, but it is quite certain that the well-cared-for orchards will continue to pay much longer than the average. But over half the orchards are not well cared for, and it is perfectly reasonable to suppose that many of these neglected ones will be gone in twenty years. The advisability of planting more orchards to take the place of these old ones is therefore worth considering. More immediate profit would come from the rejuvenation of the old orchard.

CHAPTER IX.

Soils and Soil Problems.

Topography.

Topographical regions.—Wayne county is divided into two distinct topographical regions: a very hilly or drumlin region, and a region of gently rolling land; but each of these regions has a subdivision, so that we have four divisions (see Fig. 66):

(1) A drumlin area.

(2) A region where the drumlins were once wholly or partially submerged.

(3) A gently rolling glaciated area.

(4) An area of rolling land that was formerly the old lake bed.

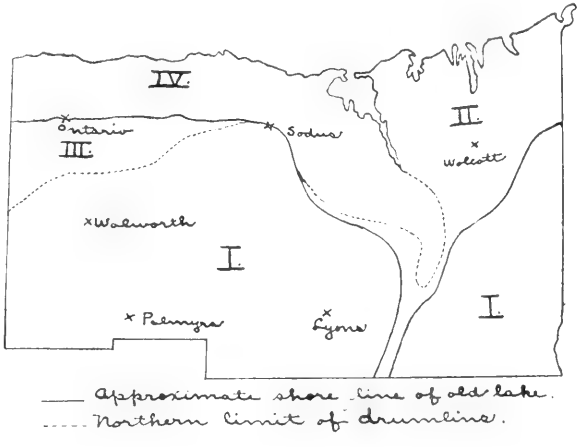

Fig. 66.—*Topographical regions. I. Drumlin area. II. Region where the drumlins were once wholly or partially covered by the lake. III. Gently rolling glaciated area. IV. Old lake bed.*

The elevations above sea level vary from 246 feet, the level of the lake, to 670 feet, the top of the highest hill. During the glacial period the lake level was about 440 feet above sea level, or about the height of the "ridge". This ridge was a sand-bar or lake shore line. The present sand-bar running across Sodus Bay probably appears somewhat as the ridge appeared during this period. (See Fig. 141.) This ridge is more or less continuous from Sodus Bay to Buffalo. It is a gravel formation ten to thirty feet high and about four rods wide on top. It makes a natural roadway and has always been used for that purpose. The Rochester and Sodus Bay trolley line, built on this nature-graded roadbed, has furnished a very important supplement to the railroads in marketing the fruit of the northern part of the county.

During the glacial period the entire county was covered with a thick mass of ice. This ice was gradually moved southward, and carried with it

the stony material that now makes up the soil of the south part of the county. This material was deposited in the long hills, or drumlins, and in the sheet of stony material that occurs between them. The depth of this covering of glacial drift varies from a few feet to about one hundred and seventy-five feet. In many places between the hills the bed-rock is very close to the surface, what soil there is having been largely brought from the hills by the rains. In some places the bed-rock is still uncovered. Many of the small streams that drain the area run on this rock. In order to drain some of the lower land, the rock must be blasted out in order to deepen the streams.

The drumlin area.—About two-thirds of the county is covered with a succession of the long north and south hills or drumlins. (See page 364.)

FIG. 67.—*Near Sodus Bay. A sandy soil. This was formerly the old lake bed. The hills in the foreground have been caused by subsequent erosion.*

These hills have a slightly northwest and southeast direction. They are from one-fourth of a mile to three miles long—usually a little over a mile—and are about one-fourth as wide as long. Their tops are from 450 to 670 feet above sea level, and rise from 75 to 175 feet above the valleys. These heights for such narrow hills give very steep east and west slopes. The north and south slopes occupy comparatively little of the area. The former are abrupt, the latter more gentle. The greater part of the elevated land, therefore, consists of very steep east and west slopes. The orchards are situated on these slopes and on some of the rolling land of lower levels. The soil type of the hills and the higher part of the lower land is the Miami stony loam. (See page 316.)

The drumlin area that was once partly submerged.—In the northeast part of the county, east of Sodus Bay, there is a considerable area where

the drumlins were once islands or were covered by the lake at the same time when the ridge was formed. (See Fig. 67.) The sediment deposited in the quiet water that filled these lower places formed the Miami silt loam (see page 317), which has proved to be an excellent apple soil. The higher-lying land is mostly the Miami stony loam and Alton stony loam. Areas of Miami fine sand also occur.

The gently rolling, glaciated area.—Between the ridge and the drumlins of Marion and Walworth townships the soil was mostly removed by the glaciers. In many places the rock is so near the surface as to interfere with the growth of apples. The soil is a good apple soil where deep enough and where there is an outlet for the water.

Area of rolling land that was once the lake bed.—North of the ridge the land was once the old lake bed. The soil is formed from sedimentary deposits in the old lake and to some extent from deposits by the glaciers. It is now a gently rolling plain with a quite variable soil. (See Fig. 144.) In many places the drainage is poor, but there are many desirable sites for orchards. The soil types used for apples are the Alton stony loam, Miami silt loam and Miami fine sand.*

Soils.

The soil types.—The chief apple soils of the county are the Miami stony loam, the Miami silt loam and the Alton stony loam. Apples are also grown on the Miami fine sand, the Ontario gravelly loam and on a phase of the Alton stony loam that has the bed-rock too near the surface.†

*For a further discussion of the topography, geology and origin of soils, see Part II of this report.

†For a more extended discussion of soils, see the report of "A Soil Survey of the Lyons Area," a reprint from the "Field Operations of the Bureau of Soils, 1902." This gives a discussion of the soils and a soil map of all the county except the west tier of townships. It is sent free to all who apply to the Secretary of Agriculture, Washington, D. C.

This report was not published at the time the orchard survey was made, so that the soil classification was independent of the Bureau of Soils, though following the same methods. More subdivisions were made in the orchard work, with the idea of combining, if the differences were found to be insufficient to warrant the separation. The Miami stony loam, Alton stony loam and Miami fine sand were each divided into two subtypes. These divisions seem to be entirely unnecessary. One subdivision of the Alton stony loam, in which the bed-rock is so near the surface as materially to affect the production of apples, is retained as a distinct type. The Ontario gravelly loam was mapped by the Bureau of Soils with the Miami stony loam and Alton stony loam. This is kept as a distinct type. The smallness of the

The Miami stony loam is the stony soil that covers the drumlins and most of the rolling land between these hills. It is a light brown loam, eight to ten inches deep, containing five to forty per cent of stone and gravel. The stones are usually small and well rounded. The subsoil is a brownish-yellow, stony loam. The proportion of stone and gravel usually increases at greater depths, but the reverse is sometimes true. The gravel is sometimes cemented together so as to form a gravel hardpan. This occasionally occurs near enough to the surface to interfere with the growth of apple-trees. Table 27 gives a summary of the average mechanical analyses of four samples of this soil.

TABLE 27.

Mechanical analyses of the fine earth of Miami stony loam. Average of four samples, three of which were taken from the report of the Bureau of Soils.

	Soil. Per cent.	Subsoil. Per cent.
Organic matter	1.96	1.13
Fine gravel and coarse sand (2 — 0.5 mm)	6.	7.
Medium, fine and very fine sand (0.5 — 0.05 mm)	44.	46.
Silt (0.05 — 0.005 mm)	39.	34.
Clay (0.005 — 0.0001 mm)	11.	13.

The Alton stony loam.—This type of soil occurs north of the drumlin area. The surface soil, to a depth of seven to ten inches, consists of brown sandy or silty loam. The subsoil is a yellowish-brown sandy or silty loam. The type contains ten to fifty per cent of stone, which generally consists of more angular fragments than those in the Miami stony loam. It also contains more fine sand or silt than that type. South of the ridge there are considerable areas of it that contain limestone fragments. Table 28 gives the averages of three analyses of this type.

TABLE 28.

Mechanical analyses of the fine earth of the Alton stony loam. Average of three analyses made by the Bureau of Soils.

	Soil. Per cent.	Subsoil. Per cent.
Organic matter	3.89	.61
Fine gravel and coarse sand (2 — 0.5 mm)	5.	4.
Medium, fine and very fine sand (0.5 — 0.05 mm)	52.	46.
Silt (0.05 — 0.005 mm)	30.	31.
Clay (0.005 — 0.0001 mm)	13.	19.

individual areas would make it difficult, if not impossible, to map it separately by the Bureau of Soils method. The Miami silt loam (called the Elmira silt loam in the Bureau of Soils report, but since changed to Miami silt loam) corresponds exactly with one of the classifications made by the writer. In general the soil types and the mechanical analyses agree remarkably well for results secured from independent work.

South of the ridge, in the west part of the county, there are considerable areas of the Alton stony loam, where the soil rests on limestone rock that is so near the surface as to interfere with the growth of apples. The soil is too shallow to admit of good root-growth or to allow good drainage.

The Miami silt loam.—This is a brown or yellowish-brown silt loam, eight or ten inches deep, underlaid by brownish-yellow or yellow silty loam. This type occurs on the rolling land near the lake and around Sodus Bay. (See table 29.)

Table 29.

Mechanical analyses of Miami silt loam. Average of four samples, three of which were analyzed by the Bureau of Soils.

	Soil. Per cent.	Subsoil. Per cent.
Organic matter	1.44	.32
Fine gravel and coarse sand (2—0.5 mm)	1.	1.
Medium, fine and very fine sand (0.5—0.05 mm)	22.	18.
Silt (0.05—0.005 mm)	64.	66.
Clay (0.005—0.0001 mm)	13.	14.

Miami fine sand.—This type is a light brown sandy loam, eight or ten inches deep, underlain by light yellow sand, usually free from stones. Its chief occurence is north of the ridge. (See table 30.)

Table 30.

Mechanical analyses of the Miami fine sand. Average of three analyses made by the Bureau of Soils.

	Soil. Per cent.	Subsoil. Per cent.
Organic matter	2.15	0.38
Fine gravel and coarse sand (2—0.5 mm)	4.	3.
Medium, fine and very fine sand (0.5—0.05 mm)	78.	85.
Silt (0.05—0.005 mm)	14.	9.
Clay (0.005—0.0001 mm)	3.	2.

Ontario gravelly loam.—This is a brown gravel underlain by a light brown gravel or gravelly loam. The predominating characteristic is the gravel. Most of the gravel is less than one inch in diameter. It occurs in small deposits in the Miami stony loam and is the common type along the ridge. It is a very open soil—too well drained. Along the ridge it is nearly all planted to apples. The deposits of gravel that occur in the drumlins are frequently used on the public roads. (See Fig. 69.)

Average yield on the different soil types.—Table 31 shows the average yields on the six different types of soil. The number of orchards on the last three types is not large enough to give positive results. The table

shows definitely that the Miami stony loam averages better than the Alton stony loam and that the soil with the bed-rock near the surface is by far the poorest of all. I believe that the four-year average shows the relative merits of the soils quite accurately, except that the average for the Ontario gravelly loam seems to be a little too high. It is certain, however, that this type usually gives a good yield. All previous discussions of apple soils, so far as I have been able to determine, would consider this a very poor apple soil.

TABLE 31.

Average yield in bushels on different soil types. Trees set before 1880.

SOIL TYPE.	1900.			1901.		
	No. orchards.	Acres.	Average yield.	No. orchards.	Acres.	Average yield.
Miami stony loam	116	542½	287	159	834¼	57
Alton stony loam	24	182	255	20	144½	33
Alton stony loam (bed rock near surface)	8	35	218	5	26	7
Miami silt loam	7	125	379	6	115	99
Ontario gravelly loam	2	17	474	7	35½	73
Miami fine sandy loam	5	41	100	6	51	93

TABLE 31—*Concluded.*

SOIL TYPE.	1902.			1903.			Four-year average.
	No. orchards	Acres.	Average yield.	No. orchards	Acres.	Average yield.	
Miami stony loam	272	1419¾	234	132	788¾	283	215
Alton stony loam	43	358	215	19	185	220	183
Alton stony loam (bed rock near surface)	12	66	151	5	29½	237	153
Miami silt loam	8	129	260	3	44	214	238
Ontario gravelly loam	12	63½	295	2	0	278	280
Miami fine sandy loam	8	63	353	7	172	220	192

Summary of the soil factor in apple-production.—While the kind of soil is important, in this locality, it is evidently not the most important factor in apple-production and is not as important as the kind of treatment that the soil receives. The kind of care required varies with the soil. The Miami silt loam will doubtless produce a good crop with less manure

than is required on any of the other types. The Miami stony loam is next strongest. The other types require larger applications of manure, but give good results when so treated. These latter are more open and are more in need of humus. The soil with the bed-rock near the surface is entirely unsuited to apples. For the best production of apples, there should be at least six feet of well-drained soil in every part of the orchard.

Drainage.

The condition of the natural drainage.—In selecting a soil for an orchard, more important than chemical or physical composition is the

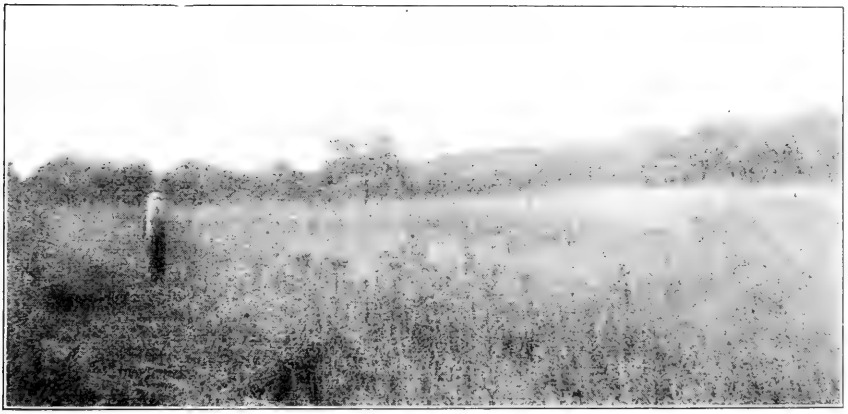

FIG. 68.—*In the center of a 35-acre orchard that is on a hill. Several acres have been gradually killed and many more damaged by ground water. This land has grown up to weeds and gives no income. It could easily be drained.*

question of drainage. No well-drained soils were found in the county that were not producing good crops of apples when properly cared for.

The majority of the orchards are on fairly well drained land. A large number would be benefited by underdrainage, but in some cases the benefit would not be great enough to pay. Some orchards have been set on such wet land that they have entirely failed; others have one corner extending down into a low place where drainage is needed; others are divided by small "draws" that need underdrains. Where the orchards are on steep hillsides it might seem as if underdrainage would be unnecessary, but there are many places where the seepage water calls for drains. In other places the long slopes accumulate such a large volume

of surface water that drains are needed. Fig. 68 shows a 35-acre orchard, in the center of which are several acres that have been drowned out. This orchard is on a high hill and has a fair slope, but it needs drainage. There is usually a strip of poorly drained land on each side of the "ridge". Kettle-holes occur occasionally in the north part of the county. In a few orchards near the lake shore there are successions of parallel waves of land, making a few rods of good soil followed by some that needs drainage.

FIG. 69.—*An excavation showing stratified Ontario gravelly loam. Too well drained!*

In the northeast part of the county several orchards were examined the foliage of which was of a reddish hue when viewed from a distance. Some of the leaves were quite red in the latter part of August. This seemed to be due to the lack of drainage. It was characteristic of foliage in undrained places. Several farmers attributed this to a "new insect" that had "stung the leaves".

The Ontario gravelly loam and the Miami fine sand drain too easily — that is, they do not retain enough water. On such soils tillage is particularly profitable. A cover-crop or barnyard manure is a necessity. They add humus and increase the water-holding capacity of the soil. Tillage and humus will make any of these soils good for apples. (See Fig. 69.)

Losses caused by lack of drainage.—Of the 1,773½ acres of orchard land in Walworth, only 182 acres have any kind of underdrainage. Most of these have only a stone drain or two in a particularly wet place. A

few have tile drains. Fifty-four orchards, aggregating 232 acres, are reported as in need of drainage. This means that, in the opinion of the inspector, some tile drainage would pay. The average yield of these 54

Fig. 70.—*A twelve-acre orchard, two acres of which are dead, and two acres damaged by lack of drainage.*

Fig. 71.—*The trees are all damaged by insufficient drainage. The grower continues to plant young trees and these are continually drowned out. It would pay better to "plant" tile drains.*

orchards in 1902 was 203 bushels, 42 bushels below the average of the other orchards in this town. Of the 1,987½ acres inspected in the remainder of the county, 317 acres have some underdrains, but 831 acres need drainage in whole or in part.

Perhaps five to eight per cent of the orchards of the county need underdrainage throughout. About thirty per cent need drainage in part. The great loss through neglect of drainage is not in the destruction or damage

FIG. 72.—A "draw" in a 150-acre orchard where the trees are being gradually drowned out. The tree in the foreground is dying but is bearing a large crop of little apples and few leaves. The owner considers it a phenomenal tree, but it will probably not bear many more crops.

of the few entire orchards, but in the loss from the few small wet places in hundreds of orchards; for there are hundreds of orchards that have from one to fifteen per cent of the trees drowned out or badly damaged. There is a low place, a "draw" (see Fig. 72), or a kettle-hole, or a place where the water seeps out, and a few trees are killed or damaged. These vacant places are in most cases waste land. If they were occupied by trees it would not add materially to the expense of caring for the orchard,

but would add very substantially to the income. Figs. 68, 70 and 71 show such areas of waste land, due to lack of drainage. Many of the trees that are not killed are badly damaged. In such places a few tile or a good stone drain would pay many times over. A manufacturer would not long allow any such loss. Why should a farmer give less attention to losses in his business?

Lack of drainage may not be apparent while the trees are young. It is a growing evil, for as the trees get larger and the roots extend deeper, they get into poorly drained and poorly aerated soil.

Fig. 73.—*In the same orchard as Fig. 68, showing the border line between the dead and dying trees. The trees are 15 years old. Their size can be seen by comparing with the small boy. The gnarly horizontal spread of the limbs is characteristic of trees that are in the most poorly drained places.*

Fig. 74.—*This orchard is ordinarily fairly well drained but in the wet seasons it suffers. The picture was taken Oct. 10, 1904. At this date the leaves had all fallen, because of the wet soil. The leaves had been falling badly for two months.*

The trees may do very well till they are about old enough to bear, then some wet season they will be damaged or even killed.

Those who propose to set new orchards should consider the question well before starting such an expensive and long-continued enterprise on soil that is not well drained naturally or artificially. It is not enough that the soil will raise an ordinary farm crop. The roots of such a crop do not go as deep as do apple-roots. Furthermore, if a corn crop is lost or damaged by water, it does not prevent raising a good crop next year. When an apple orchard is damaged one can not start over the next spring as if nothing had happened. The corn is an annual, a one-year investment; the apple, a perennial, a long-time investment.

CHAPTER X.

Elevations and Exposures.

Sites.—The sites are classified as elevated, or well up on the hills; moderately elevated; slightly elevated, and low. Table 32 shows the areas of each division.

Table 32.

Sites of orchards. Table includes all ages of trees.

	Walworth.		Remainder of Co.		Entire County.	
	No. orchards.	Acres.	No. orchards.	Acres.	No. orchards.	Acres
Elevated	158	790½	34	359	192	1149½
Moderately and slightly elevated	133	495½	91	1488	224	1983½
Low	147	487¼	10	140½	157	627¾

Relation of the sites to yields.—The yields do not indicate any particular advantage for any of the divisions. The four-year average in Walworth on elevated sites was 227 bushels; moderately and slightly elevated, 224 bushels; low, 213 bushels. For the remainder of the county

Fig. 75.—*An orchard on the east side of a drumlin.*

the differences are about the same but are in the reverse order. Evidently the site is not a very important factor. The best site is doubtless one that is sufficiently elevated to give good opportunity for air and water-drainage, but not so high as to be sharply exposed to wind.

The aspects or exposure.—The majority of the orchards in the drumlin area are on east or west slopes occupying the sides of the drumlins (see Fig. 75 and page 364). There are, however, many orchards on the rolling land of lower levels, and in the north part of the county, where there are

no drumlins, the land is rolling. Table 33 shows the predominance of east and west slopes in Walworth.

TABLE 33.
Aspect.

Exposure.	WALWORTH.	
	No. orchards.	Acres.
N	25	80
N. E.	27	88
E	84	313½
S. E.	19	74½
S	26	91½
S. W.	20	74
W	71	268
N. W.	15	61
Level	45	129¼
Rolling*	106	593

*Most of those classed as rolling are a combination of east and west slopes. The south part of the county has equally marked east and west slopes. The north part is rolling.

The effect of aspect on yields.—The easterly slopes in Walworth gave a larger yield each of the past four years than have the westerly slopes. The difference in 1902 was 23 bushels per acre in favor of the easterly slopes. In each of the other years the difference was greater. The north part of the county does not show this marked uniform difference. The differences are greater than one would expect. In each of the four years the northeast slopes have exceeded the northwest, the east have exceeded the west; the only exceptions are that in two cases the southeast have failed to exceed the southwest. The four-year average in Walworth was 43 bushels in favor of easterly slopes.

It seems safe to conclude that the easterly slopes have marked advantages over the westerly. This is due to the protection from the strong west winds which do considerable damage at times. In the first part of June, 1903, the leaves of the west rows in many orchards were badly injured by winds. In many cases the foliage looked brown from the distance. The outer part of most leaves was damaged and many entire leaves were killed. The effects were still apparent in July. These strong west winds also cause more loss from windfalls on the west sides of the hills. The orchards on the level exposures give the least yields of all, a difference that is probably due to poorer drainage.

CHAPTER XI.

A Comparison of Rented Orchards with those Managed by the Owner.

Census of rented orchards.—Between twenty and twenty-five per cent of the area devoted to apples is rented. (See table 34.) The usual method of renting an orchard is the share system. The renter takes entire charge of the orchard and delivers a certain share of the crop—usually half—to the owner. A cash rental is not uncommon, but is given in a much smaller number of cases. Many of the renters do not remain on one farm longer than one or two years.

Table 34.

Area of rented orchards and of those not rented. Trees set before 1880.

Proprietor.	Walworth.			Remainder of County.			Entire County.		
	No. orchards.	Acres.	Per cent.	No. orchards.	Acres.	Per cent.	No. orchards	Acres.	Per cent.
Owner	243	1,080¾	81	85	1,451	75	328	2,531¾	77
Renter	64	259½	19	37	487½	25	101	747	23

Effects of the rental system on the health of the orchard.—The large number of rented orchards gives rise to a serious problem in orchard management. When a man rents land for the growth of field crops, there is not only a definite basis for the rent but there is also an unwritten law that has established quite definitely how he should raise these crops. There are no such definite customs that determine the care which a rented apple orchard should receive.

The greatest obstacle in the way of good care is the fact that the returns for good treatment do not come immediately. Good care of field-crops gives an immediate effect; good care of an apple orchard may give less returns the first year than it gives several years later. A renter does not like to plow up a pasture that is of immediate value for the benefit of a future apple-crop. If he mows the grass, he is not likely to leave it for a mulch, unless it is not good for hay. The farm manure will bring him quicker returns if used on the field-crops. The greatest return which

he gets from pruning may be in the fire-wood procured, and some of the pruning is therefore done so as to get the most wood with the least work. If he has no crop, he does not see the profit in spraying for the benefit of a future crop that he may not reap.

All these points are emphasized when the renter is certain that he will not stay another year. Their effect on the tree is partially indicated by the average yields. This average for the past four years has been 174 bushels for the rented orchards and 210 bushels for those not rented. (See table 35.)

TABLE 35.

Yields of rented orchards compared with those not rented. Trees set before 1880.

PROPRIETOR.	WALWORTH.			REMAINDER OF COUNTY.			ENTIRE COUNTY.		
	No. orchards.	Acres.	Average yield.	No. orchards	Acres.	Average yield.	No. orchards.	Acres.	Average yield.
1900.									
Owner	94	387¼	332	31	542	247	125	929¼	283
Renter	13	75½	305	15	242½	232	28	318	249
1901.									
Owner	118	607¾	64	32	567	49	150	1174¾	57
Renter	20	113	36	23	367½	47	43	480½	45
1902.									
Owner	196	935¾	262	61	1004½	217	257	1940¼	239
Renter	45	208½	166	28	395½	183	73	604	187
1903.									
Owner	99	580¾	280	33	575½	239	132	1156¼	260
Renter	12	70	222	9	178½	215	21	248½	216

Four-year average:

Managed by owner..... 210 bushels
Managed by renters..... 174 "

The attitude of the renter is, on the whole, about as good as that of the owner of a rented farm. Owners are usually very slow to spend money on improvements, or in keeping up a place. Both men often squeeze the farm for the last penny and let the future look out for itself.

In a very few cases the difficulty has been overcome by a contract with the renter, that he is to give the orchard certain definite care. One such contract calls for at least two sprayings and two cultivations.

Suggestions and reflections on the rented farm.—Many renters would be glad to improve the orchard, but the pruning and renovation of a neglected orchard is an expensive undertaking. One cannot afford to do this unless he has a lease for several years, or unless the owner helps to pay the cost. The owner does not like to spend money for such work, for he feels that he will likely have a poor tenant about the time that the orchard gets in good shape. Some have taken the broader view and have spent money in the renovation of the orchard. These have almost invariably been well repaid by the increased income. An owner who takes a pride in keeping up his place and who is willing to spend money, if necessary, in improving it, stimulates the renter by his own interest. Such a man also attracts the better class of renters. He may occasionally have a very poor one, but the average is certainly much above that found on the farm where the owner begrudges new shingles on the barn. The renter sometimes takes so much pride in his work that he will take good care of an orchard even if he does not expect an immediate return. This is also a good investment for such a man becomes known and can therefore secure a farm more readily and sometimes on better terms.

Unquestionably the most effective way to bring the rented orchards up to the average is to give leases for a longer time. The commonest reason for not doing this is the fear that a shiftless tenant will secure the place and retain it. There is abundant reason for this fear, but if the renter changes every year or two, the chances of a bad one at some time are multiplied. Such a man may do more damage in one year than can be overcome in many years. A fairly good man, or even one that is below the average, if kept from year to year will give better results than a rapid succession of good and bad tenants.

As one travels through orchard after orchard, he becomes more and more impressed with the desirability of maintaining the American ideal of every farm owned by the man who works it. But if the owner secures the best renter possible, gives him a lease of several years, requires good care of the orchard, and then is willing to bear part of the expense of renovating the orchard where this is necessary, the renter ceases to be a menace to the apple industry.

CHAPTER XII.

Varieties.

The varieties grown.—Nearly all the bearing orchards are made up of a mixture of Baldwin and Rhode Island Greening, with a few trees of other kinds. There are more Baldwins than of all other varieties combined. Probably eighty to ninety per cent of all the trees are either Baldwin or Greening. The larger part of the balance are Tompkins King, Northern Spy, Twenty Ounce and Roxbury Russet. There are some trees of many other varieties but the numbers are so small as to be unimportant in comparison with the above kinds. Some of these less important varieties are: Hubbardston, Ben Davis, Esopus Spitzenburg, Wagener, Duchess of Oldenburg, Red Astrachan.

The young orchards also differ much in varieties, but the larger part are planted to Baldwin, Ben Davis, Greening, Hubbardston. Other varieties that are being planted to a very limited extent are: Duchess of Oldenburg, Wealthy, Wolf River, Mann, Grimes Golden, Rome Beauty, Maiden Blush, Red Astrachan, Northern Spy, Russets, Snow, Yellow Bellflower, Boiken, McIntosh Red, Gravenstein, Sutton Beauty, Bismark, etc.

Variations within the variety.—"We know that no two trees in any orchard are alike, either in the amount of fruit which they bear or in their vigor and habit of growth. Some are uniformly productive and some are uniformly unproductive. We know, too, that scions or buds tend to reproduce the characters of the tree from which they are taken. A gardener would never think of taking cuttings from a rose-bush, or chrysanthemum, or a carnation which does not bear flowers. Why should a fruit-grower take scions from a tree which he knows to be unprofitable?

"The indiscriminate cutting of scions is too clumsy and inexact a practice for these days, when we are trying to introduce scientific methods into our farming."*

Long ago men learned that two cows were not necessarily alike because they were both Jerseys. The man who would raise cattle from any individual merely because it belonged to the desired breed would be ridiculed. But there are as great differences between Baldwin apple-trees as there are between Jersey cows.

*L. H. Bailey, Cornell Bulletin 102, Oct., 1895.

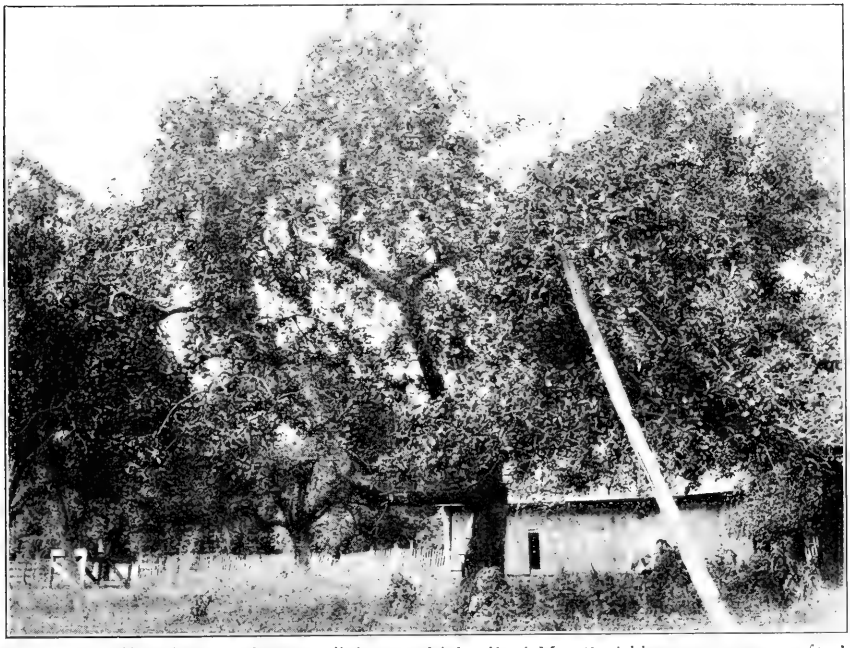

FIG. 76.—*The old "mother tree" from which all of Mr. Smith's trees were grafted. It bears excellent apples and good crops of them. About 500 trees have been grafted from this tree.*

FIG. 77.—*Trees in Mr. Smith's young orchard. Top-worked with scions from the "mother tree."*

When the farmer has top-grafted his trees, as is sometimes done for other reasons, there has probably been more or less unconscious selection from good trees. Few nurserymen have yet paid any attention to the matter, nor are they likely to do so till fruit-growers are willing to pay for the increased work.*

One good example of care in the selection of scions was seen in Orleans county. Fifty-three years ago Mr. Russell Smith of Albion grafted one tree to Baldwin. This proved to be so exceptionally productive that he grafted some of the other trees in the same orchard with scions from it. A few years later another orchard of three acres was planted. A large part of these trees were top-worked to Baldwin with scions from the original tree. In 1868 his sons, S. W. and William Smith, decided to plant ten acres more. They bought good Northern Spy trees for stocks and top-worked them to Baldwin. Most farmers would have taken the scions from the young orchard because longer and better-looking shoots could have been obtained, but they were not satisfied to do this. They went to the original "mother tree" for all the scions. This mother tree is still living and producing apples. "It is literally bearing itself to death." (See Fig. 76.) The orchards grafted from it are all producing large crops. (See Fig. 77.) Of course there are plenty of good trees in New York that were budded or grafted with scions taken from young trees or that were taken indiscriminately from old trees, just as there are good cattle that were produced without any care in breeding. Some good ones will certainly be secured by accident, but the scientific fruit-grower eliminates all accidents so far as possible. He increases his chances for success when he secures good nursery-grown stock and top-works it from trees of bearing age—trees of known productiveness, vigor and quality.

*J. H. Teats & Sons, of Williamson, are growing "pedigreed" peach trees. They have several good orchards, but have only a few trees that they consider good enough to bud from. Such a tree must be hardy, it must bear the best peaches and plenty of them. They find that the public is willing to pay more for these trees than for trees where no selection has been practiced.

CHAPTER XIII.

Enemies of the Apple.

The more serious enemies.—The codlin-moth and the scab fungus are the most serious enemies of the apple in Western New York. The scab is not so injurious if the apples are to be evaporated, but it probably causes more loss than any other enemy when apples are to be barreled. It was very destructive in 1902, was of small importance in 1903, and was very prevalent in 1904.

Of the insects that attack the tree, the canker-worm (commonly called "army worm") has done the most damage, but it is now practically subdued. Probably the wood-rot fungi have done more to shorten the lives of the trees than any other enemy. These gain entrance through wounds and rot out the trunk so that the trees eventually break down. (See pruning, Chap. IV.) Canker of the limbs has done much damage and has killed a number of entire orchards. (See page 341.) The collar rot, "King disease," or "winter injury," as it is variously designated, is the worst enemy of King and Spitzenburg varieties. It is not so serious with other varieties. (See page 345.)

In addition to these there are many kinds of insects and diseases that do a small amount of damage every year. In their ups-and-downs sometimes one and sometimes another becomes serious. The bud-moth probably did as much damage as any other insect in 1903. Aphids were the worst enemy of young trees and caused considerable damage in old orchards. They were worse on thrifty trees than on slow-growing ones. The best orchardists therefore suffered the most loss from them. The apple bucculatrix, or ribbed cocoon-maker of the apple, the apple weevil and the mites each did considerable damage in a few orchards. Table 36 indicates something of the relative importance of the various enemies in 1903.

Table 36.

Insect and fungous enemies of the apple in 1903.

	Injury.	No. orchards.	No. acres.
Canker (*Sphaeropsis malorum*)	serious	87	526½
	considerable	83	729½
Bud-moth (*Tmetocera ocellana*)	serious	45	590¾
	considerable	37	221
	slight	148	614¼
Codlin-moth (*Carpocapsa pomonella*)	serious	61	333½
	considerable	45	631
	slight	all bearing orchards	

TABLE 36—*Concluded.*

	Injury.	No. orchards.	No. acres.
Collar rot	considerable	31	212
	slight	nearly all old orchards	
Aphis (*Aphis pomi*)	serious	55	458
	considerable	44	324½
	slight	all orchards	
Scab (*Venturia inaequalis*)	serious	66	424½
	considerable	68	440
	slight	all bearing orchards	
Apple-weevil (*Anthonomus quadrigibbus*)	serious	13	87½
	considerable	13	79½
	slight	28	182
Apple bucculatrix (*Bucculatrix pomifoliella*)	serious	7	73
	considerable	9	156½
	slight	all old orchards	
Canker on leaves (*Sphaeropsis malorum*)	serious	4	94
	considerable	3	67
	slight	1	4
Leaf-blister mites	serious	4	25½
	considerable	6	34
	slight	56	372¼
Leaf spot (*Phyllosticta sp.*)	serious	5	44
	considerable	9	383½
	slight	nearly all orchards	
Leaf sewer (*Phoxopteris nebeculana*)	serious	4	43
	considerable	7	104
	slight	33	719
Canker-worm (*Paleacrita vernata*)	serious	3	21
	considerable	3	12½
	slight	3	27½
Tent caterpillar (*Clisiocampa americana*)	serious	1	10
	considerable	2	6½
	slight	36	146½
Woolly aphis (*Schizoneura lanigera*)	serious	2	6
	considerable	4	22
	slight	nearly all orchards	
Fall web worm (*Hyphantria cunea*)	serious	0	0
	considerable	2	3½
	slight	27	479½
San José scale (*Aspidiotus perniciosus*)	serious	0	0
	considerable	1	4
	slight	1	2

This table includes all the enemies that were found to be serious in any orchard, except borers and the wood-rot fungi. Many other insects and fungi were seen but were not doing any considerable harm.

Common notions regarding orchard enemies.—It is interesting to note the enemies that have impressed themselves on the minds of the orchardists. In answer to the question as to what insects or diseases had damaged the orchard in the past, the canker-worm was mentioned for 173 orchards, scab for 120, tent-caterpillars for 112; codlin-moth came fourth. No other enemy was mentioned more than five times. Among those mentioned were canker, borers, San José scale, pink rot, case-bearers, collar rot, leaf-roller, oyster-shell bark louse, aphids, handmaid moth, curculio, palmer-worm. Losses due to mice, sun scald and russeting of the fruit were also mentioned.

The Apple-Scab Fungus (*Venturia inaequalis*).

Importance of this disease.—The worst disease with which the apple-grower has to contend is the apple-scab, commonly called "the fungus." More questions are asked about it than about any other enemy of the apple, and there is great difference of opinion among farmers as to what it is and what to do about it. True, spraying has become an accepted practice and the best fruit-growers practically eliminate the scab, but the majority of farmers do not do so. The varying opinions are due to the fact that the fungus is invisible or inconspicuous until it "goes to seed." A knowledge of its life history is essential to any intelligent treatment of it. It has been frequently described, but the information is not yet sufficiently disseminated. I shall, therefore, attempt to answer some of the common questions that are asked about it. A few questions are asked over and over again. "What is the fungus?" "What causes it?" "Why is it worse in wet seasons?" "Why are some varieties more affected than others?"

Fig. 78.—*Young apples severely attacked by the scab fungus.*

What is the scab fungus?—"This apple-scab is no new pest. It has no doubt been seriously present ever since apples were grown in the country, causing many failures of crops which were laid to the weather or the moon."*

This fungus is a very small plant that grows as a parasite on the leaves and on the apple,—the apple is its soil. We might say that it is a weed that grows on the apple and allied fruits rather than on the ground. It lives over winter on the fallen leaves and perhaps to a very limited extent on the branches. "Scab makes its first appearance early in the spring, usually soon after the leaves begin to unfold, and it is while these and the fruit are in a young condition that the fungus can best infect them."† (See Fig. 78.) The seed (spore) falls on the

*L. H. Bailey in Cornell Bulletin 84, Jan., 1895.

†George P. Clinton, Bul. 67, Univ. of Ill. Agr. Exp. Sta. Dec., 1901.

young apple or on the leaf and there grows, sending its roots (mycelium) into the tissues of the apple. At first the infected spot is invisible, later it causes the skin to take on a deep olive-green color, but it is seldom noticed until still later in the season when it breaks through the skin and causes the black scab. Fig. 79 shows an apple that has just reached this stage. The outer skin of the apple is breaking away exposing the black fungus, which has now "gone to seed." In time the spores are blown and washed away and some of the fungus cells and dead tissue are more or less worn away so that the color may become a reddish-brown, due to the exposed dead corky tissue. The scab spots on the left in Fig. 80 show the spores and fungus cells beginning to leave from the center of the spot. The large scab on the right shows the rusty scar that is left after the disease tissue has scaled off. Farmers describe this change by saying that "the fungus leaves the apple," or "the fungus changes to rust." If this takes place before the apple is picked, the appearance

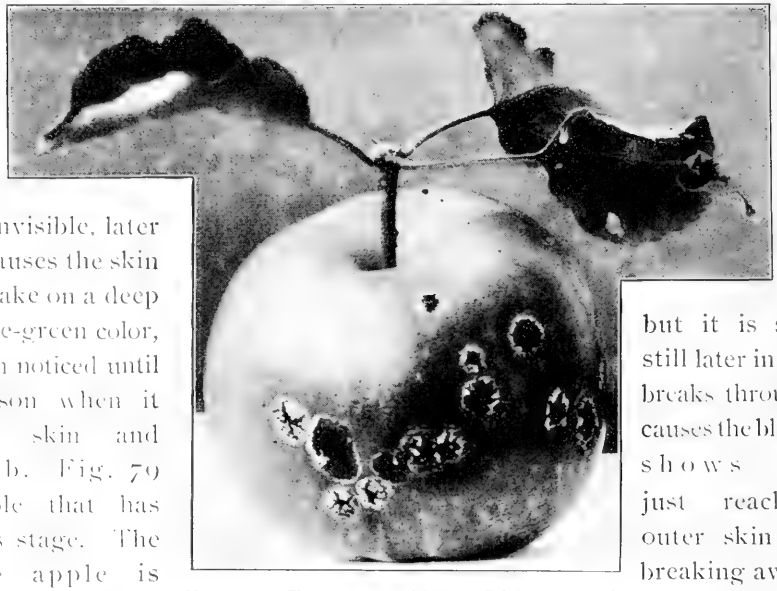

FIG. 79.—*The outer skin (cuticle) ruptured, exposing the fungus.*

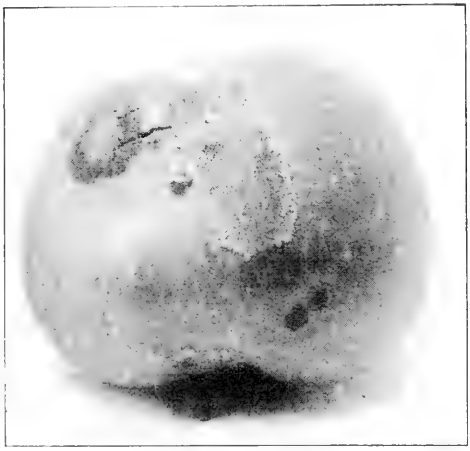

FIG. 80.—*The diseased tissue scaling off from the apple.*

and keeping quality are not so seriously affected as when picked in the stage shown in Fig. 79, but the fungus may make some further growth around the edge of the scar if put in warm storage.

Fig. 81 shows a Baldwin apple so badly attacked that it has become distorted and cracked. Most cases of cracking of the apple are due to this fungus.

Fig. 82 shows three sections of apple-leaves. "In Fig. 1 the leaf is healthy. Observe the regularity of the three upper layers of cells. In Fig. 2, the brown fungus may be seen growing on the upper surface, and at this stage it has destroyed the upper or epidermal cells, although it is probable that the mycelium of the fungus first spreads just under the cuticle, on top of the layer of epidermal cells. Fig. 3 shows the fungus when it is better established, and it will be seen that all the cells of the leaf are disarranged, the chlorophyll or green grains being few in number, and the leaf has increased in thickness. This, Fig. 3, is a cross-section through one of the blister-like elevations which are shown on the leaf in Fig. 83. It will be seen that the fungus does not enter the deeper tissues of the leaf, although it disorganizes them by its parasitic effects. In Fig. 3, a spore can be seen at A, and two are shown broken off their stem or hyphae at B. In Fig. 2 the spores can be seen in process of formation at the ends of the threads, and at C one of the threads is cut off."*

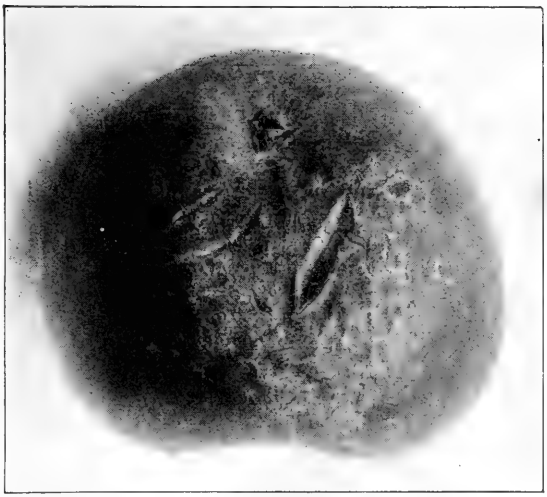

Fig. 81.—*Baldwin apple showing cracking due to the fungus.*

Relation of the weather to the scab fungus.—Nearly all fungi are favored by wet weather; wheat rust, bean rust, potato blight, etc., are all worse in wet seasons. The wet weather does not create any fungus

*L. H. Bailey in Cornell Bulletin 84, Jan., 1895

any more than favorable weather creates a corn crop. A fungus cannot develop unless the spores get on the host plant any more than a corn crop can be grown without planting the seed. But there are usually plenty of spores on hand so that all they need is weather favorable to their growth. Unusually wet weather during the blossoming period favors the growth of the scab fungus. For the same reason it does more damage in shady, unpruned and undrained orchards. Dense tops prevent the evaporation of the moisture. Open tops allow the air to circulate freely, and they therefore quickly dry out after a rain or dew.

Some varieties are more affected than others.—The Snow, Spitzenburg and Maiden Blush are particularly subject to scab. The Greening and Twenty Ounce are more affected than the Baldwin. Golden Russet and Hubbardston are among the more resistant varieties. The difference is probably due to the more tender outer skins of some varieties. The fungus must penetrate the outer skin before it can do any damage. It is interesting to note that while the Greening apples are much more affected than the Baldwin, yet the Baldwin foliage is very much more affected than that of the Greening.

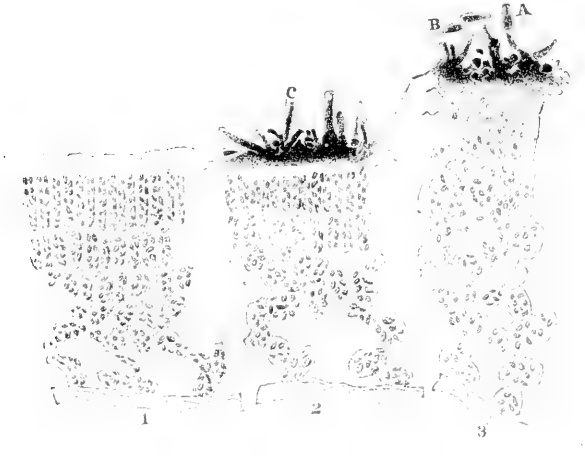

FIG. 82.—*Cross-sections of apple leaves. 1. Healthy leaf. 2. The upper surface attacked by the scab fungus. 3. A later stage in the growth of the fungus.*

Relation to other fungi.—The scab fungus is often confused with other fungi that secure a foothold in the wounds caused by the scab. Part of this confusion is doubtless due to the fact that the scab is almost always called "the fungus." It would be well if farmers would call it the apple-scab, in order to distinguish it from the hundreds of other fungi. The scab fungus causes the dark spots on the apple that may later change to rusty spots. It is never white. The white moulds that sometimes grow on these same spots are other fungi that could not have

hurt the apple had the skin not been broken by the scab or by some injury. One of these, the pink rot, caused much damage in 1902.*

Treatment.—A sufficient number of thorough sprayings with the Bordeaux mixture will keep the apples practically free from scab. The essential points are thoroughness and promptness. Spraying after the scab becomes established does little or no good. Some men have been surprised to see the scab develop under spots where the spray was still visible. This simply means that the spraying was too late—the fungus was already in the apple.

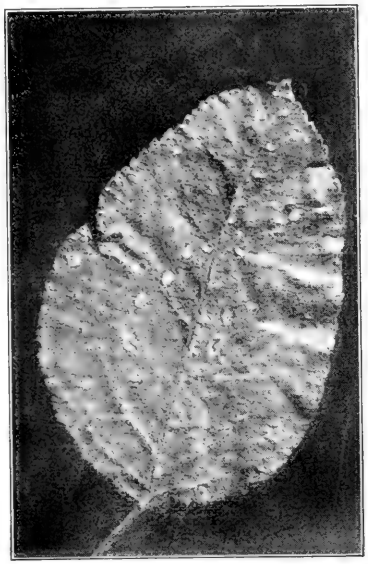

Fig. 84.—*Leaf spots probably caused by Phyllosticta sp.*

Since the spores do not all germinate at once, we should not expect one application of Bordeaux to keep off all the scab any more than we would expect one cultivation of a corn crop to kill all the pigweeds. One application if made at the right time will, however, frequently make a great difference. Three sprayings at the right times will nearly always keep the apples free from scab. Two will sometimes do so. A further discussion of the method of summer treatment and of winter treatment will be found under spraying. (Pages 392 to 394.)

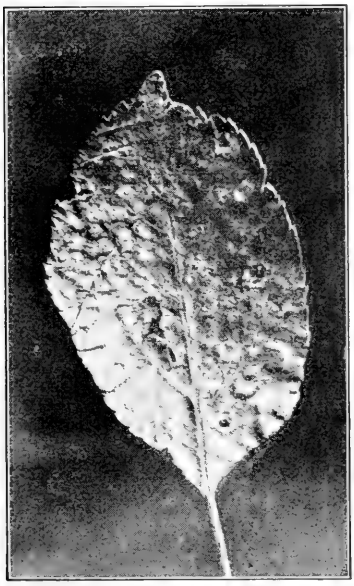

Fig. 83.—*The scab fungus on the leaf.*

Leaf spots caused by the scab fungus.—Fig. 83 shows the large blister-like elevations caused by the scab. These spots usually occur on the upper surface, but are not confined to that surface. Late in the season they are nearly black, the color

*Cornell Bulletin 207.

of the scab on the apple. Scab did considerable damage to the foliage in unsprayed orchards in 1904.

Leaf spots caused by other diseases.—Fig. 84 shows the spots caused by a different fungus, probably *Phyllosticta.* These spots are of a reddish-brown color. They do not blister the leaf. This fungus did little damage in 1903, but in the wet season of 1904 it caused much damage to the leaves. Spraying seems to have had little or no effect in checking this disease.

The so-called "yellow leaf" that caused the leaves to fall during July and August was partly due to this trouble and partly due to wet soil. Many orchards that are ordinarily well drained were wet this year. (See Fig. 74.) Those that are ordinarily too wet were very bad in 1904. The leaf spot was generally much worse in the poorly drained orchards. In some orchards the scab on the leaf and the mites also caused leaves to fall.

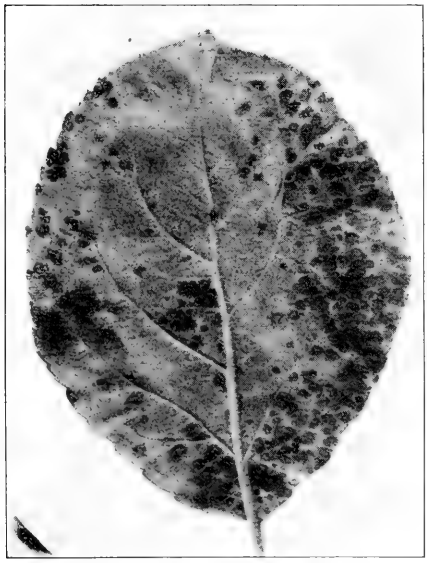

FIG. 85.—*Under side of leaf, showing leaf blisters caused by mites.*

Leaf-blister mite.—Fig. 85 shows the under side of a leaf infested with the blister mite. This had not been reported as occurring on the apple until it was found during the orchard survey in Wayne county. Specimens were sent to Professor Slingerland, who wrote as follows concerning them: "The pear-leaf-blister mite is now a well-known pest in many sections of the country, but never before until last summer had we seen or heard of a similar pest in apple-leaves. Scattered through central New York there were many apple-trees with many of their leaves showing the corky blisters characteristic of these mites. We have not yet made a careful study of the mites to determine if they are the same as the pear species. The blisters in the apple-leaves differ slightly from those in pear, but this may be due to the different food-plants."* These mites were found in 53 orchards in 1903 and were found in many orchards

*Bulletin 46. Division of Entomology, U. S. Department of Agriculture.

in Orleans county in 1904. They were not very bad in more than a half dozen orchards in each county, but in a few orchards some trees had practically every leaf affected. Their local distribution even in the severe cases seems to indicate that they do not spread rapidly. The ordinary spraying has no effect on them, because they live within the leaf where poison can not reach them. It is probable that kerosene emulsion applied before the buds open would kill them.

Injuries due to these three causes and to many other enemies that attack the leaves are quite commonly confused with each other and with spots that are sometimes caused by spraying.

The Apple-Tree Canker (*Sphaeropsis malorum* Pk.).

Description.—The black, rough bark and partially girdled limbs are so characteristic of this disease that it is easily recognized. (See Fig. 86.) The diseased part may extend for several feet along the branch, or may be only a small spot. Usually it is five to ten inches long. The bark may be merely roughened and black (as in *B*, Fig. 86) or the limb may be partially girdled (as in *A*, Fig. 86). In the worst cases the dead limbs stick out all over the tree-top. (See Fig. 87.)

Extent of the injury.—The canker causes more loss than any other disease except the scab fungus and, possibly, the fungi that cause the trunks to decay when improperly pruned. It was found to be very serious in 14 per cent of the orchards and was doing considerable damage in 19 per cent. Injuries of this character are less conspicuous but are much more serious than those that affect the leaves—canker attacks the tree directly. It does not often do much damage on young trees. It usually occurs on limbs two to three inches in diameter, but sometimes attacks the twigs or larger limbs. It very rarely occurs on the trunks, except on the Twenty Ounce. This variety is particularly subject to the disease. I have seen very few mature Twenty Ounce trees that were not badly infected. It is also serious on the Spitzenburg. The Baldwin is more affected than the Greening, Russet, King or Northern Spy.

The same fungus occurs on the leaves, but does not seem to be serious. In Wayne county in 1903 it was found on the leaves in eight orchards and was doing considerable damage in seven of them. It was not found on the foliage of any orchard examined in 1904. On the leaf it shows a distinct series of concentric circles. One infected point may develop

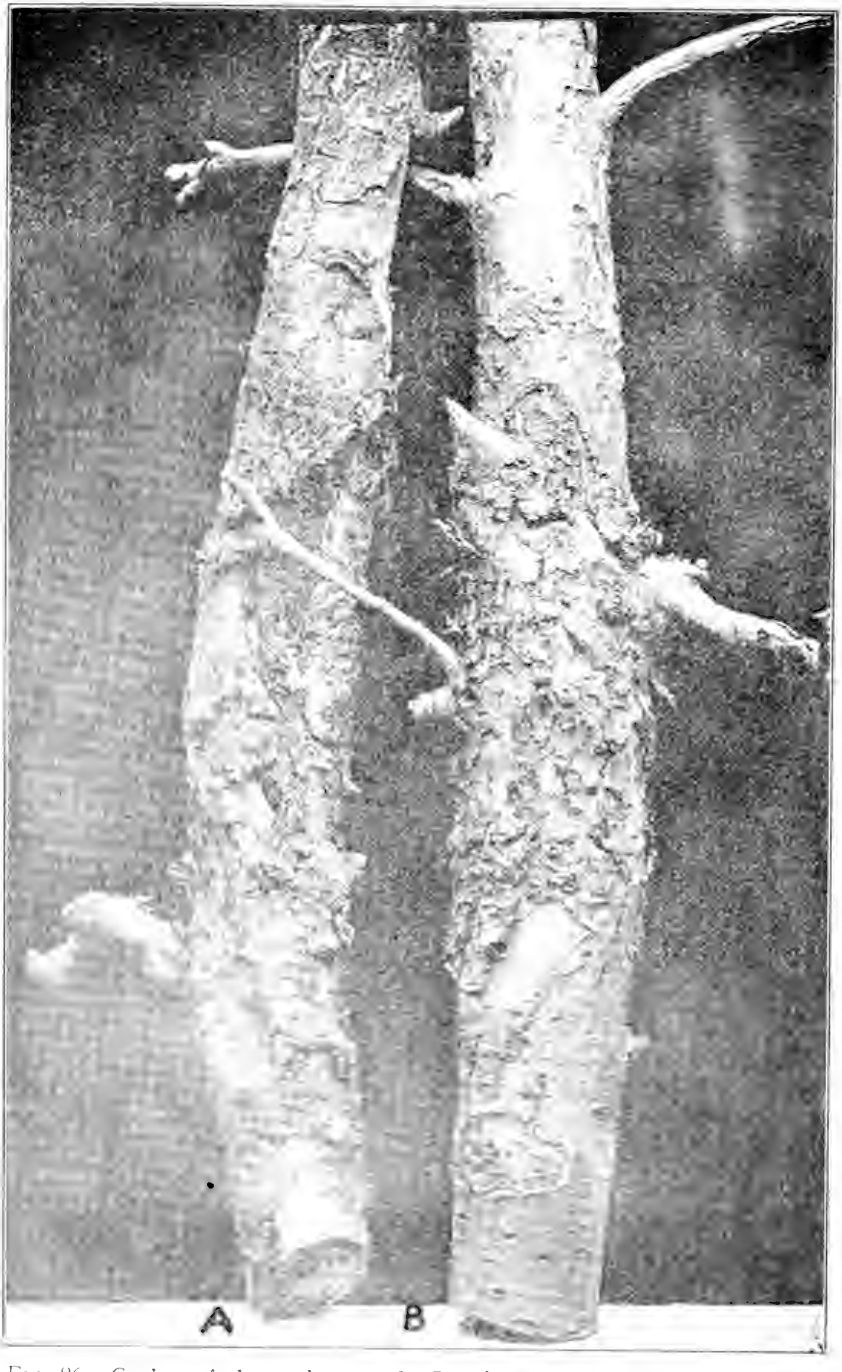

FIG. 86.—*Canker of the apple-tree. In B only the outer bark is affected. A shows the branch half girdled.*

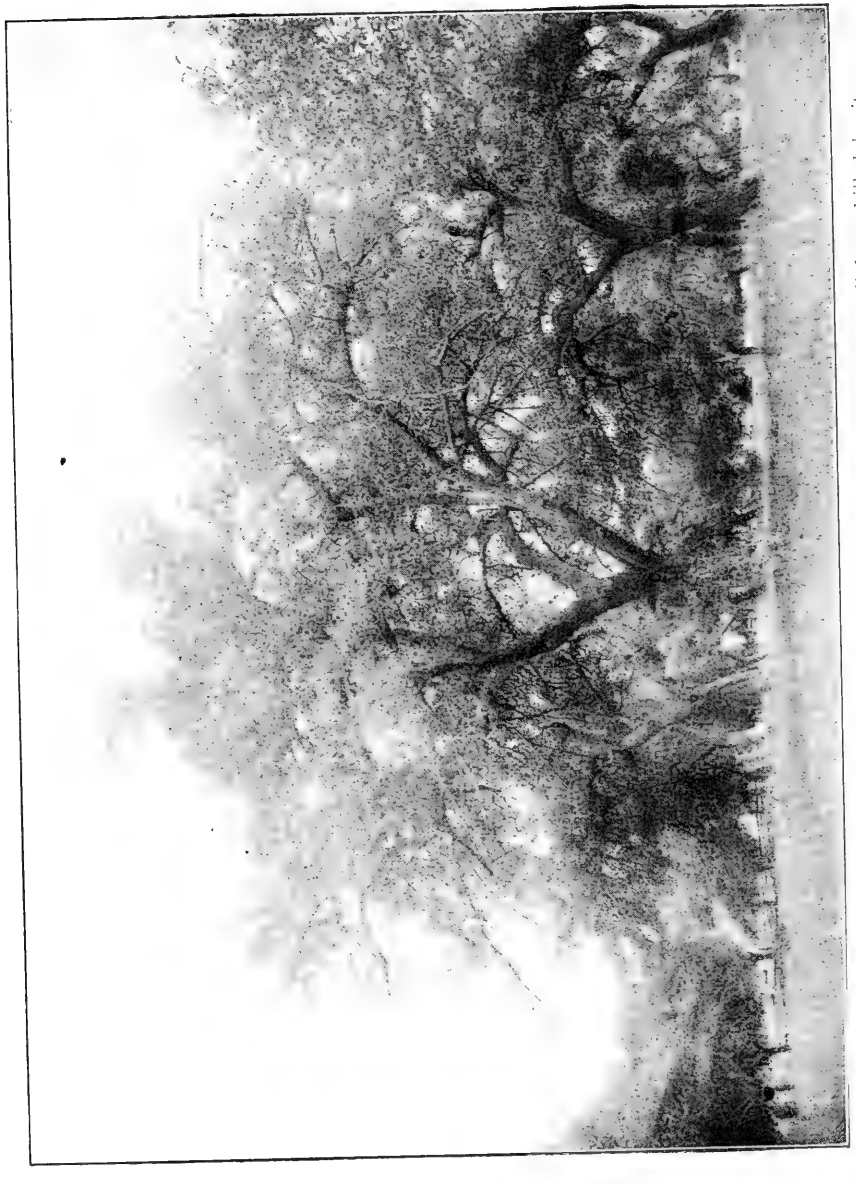

Fig. 87.—An orchard badly infested with canker. The dead limbs have all been killed by it.

to nearly half an inch in diameter. The brown rot of stored apples is also due to the same fungus.

Cause.—The cause was not known until about six years ago, when it was worked out by Wendell Paddock of the Geneva station.* Until that time it was commonly attributed to sun-scald. Comparatively few fruit-growers are yet informed of the real cause. It is still attributed to sun-scald or lightning, or passes as "dead limbs" without any cause. Practically no sun-scald has been seen in either of the counties studied.

Mr. Paddock found that the canker is caused by a fungus that grows on the bark and cambium† layer of the tree. The black color of the canker is partly due to the spore-fruits of the fungus. Many of the spores (seeds) remain on the branches till spring or longer, when they are given off and disseminated. The fungus seems to be unable to penetrate to the cambium layer through living bark. The cankers are thought to be formed by those spores that chance to fall in some slight wound and there germinate and produce more cankers. Sometimes the fungus grows for some distance on the outer bark without penetrating to the cambium. (See *B*, Fig. 86.) In such cases no direct injury is done to the tree, but spores are produced and disseminated so that a constant source of infection is maintained.

Treatment.—With the exception of the Twenty Ounce, no orchard in which the trees have always been kept in a good growing condition has been found to be seriously affected. Something more than thrifty growth seems to be necessary in order to prevent the destruction of the Twenty Ounce.

A few farmers in Wayne county and more in Orleans county have been treating the disease during the past few years and have had excellent results. The essential points of the treatment are:

(1) Prune out the limbs that are badly diseased.

(2) Spray the limbs with Bordeaux mixture.

(3) Most important of all, get the trees to growing.

Mr. G. D. Simpson of Carlton has carried the treatment a step farther. When pruning he scraped off the rough, diseased bark around each canker and gave a generous application of strong blue vitriol. This was undoubtedly a good thing, but the treatment given above seems to be invariably successful.

*New York Agricultural Experiment Station, Bulletin 163, Dec., 1899.

†The cambium layer is a tissue that lies between the wood and the bark. It is the tissue that produces the new wood and inner bark.

Mr. Albert Wood of Carlton Station has even grown new tops on his Twenty Ounce trees and has kept the new growth from becoming diseased by spraying the limbs and by keeping the trees growing. This variety is so subject to canker that it can not be kept healthy without constant vigilance.

Collar Rot.

Occurrence and description.—In nearly every mature orchard one comes across some trees on which the bark around the base is dead and loose, or has fallen away. The injury usually extends only 6 to 18 inches above the ground, but sometimes it extends 3 to 4 feet up the trunk. As the area of dead bark increases, the tree may be entirely girdled. (See Fig. 88.) It is quite commonly attributed to the hired man having hit the tree with the machinery when working in the orchard, and the injury does resemble a wound made by hitting the trunk at the surface of the ground. But before the blame can be fixed on the hired man we must explain how he happened to hit all the King and Spitzenburg trees and missed most of the Baldwins and Greenings, also why the disease is as bad or worse in those orchards that have not been tilled.

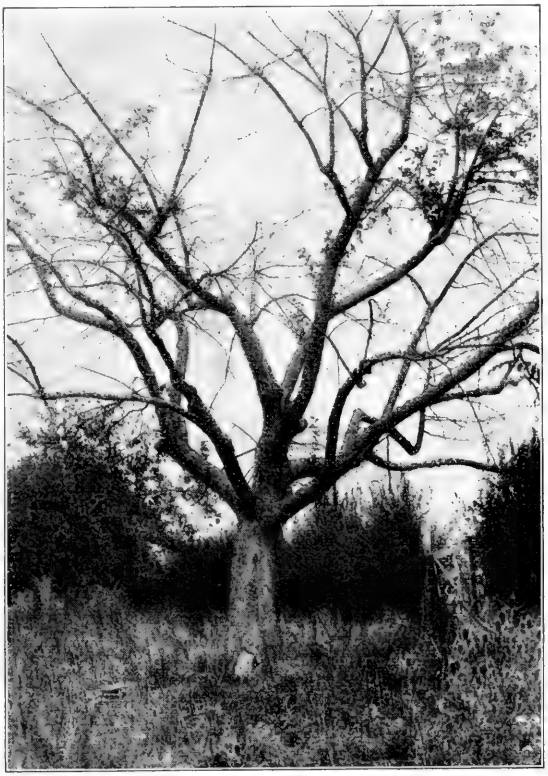

Fig. 88.—*A Baldwin tree killed by collar rot. Note the spot at base of tree. In this twenty-acre orchard about one-third of the trees are dead and one-third more are badly affected. In this case the very poor drainage has been largely responsible.*

This disease is the worst enemy of the King apple. It has sometimes been called the "King disease."* Probably the majority of all the trees

*Bulletin 191, N. Y. Agr. Exp. Sta.

FIG. 89.—*Collar rot of the King, showing diseased and cracked condition of bark.*

decay and frequently girdle the tree.

Treatment.—Little can be done except to treat the wound as any other wound should be treated. If the dead bark is cleaned away and paint applied, it will delay the decay of the wood. In some cases this has preserved the wood and the wound has healed over.

The effective treatment must be prevention. If hardy stocks are planted and top-worked to King or Esopus Spitzenburg, the trouble is avoided. (See Fig. 92.) The losses of Baldwin from this disease are not very great, but are enough so that it might pay to top-work them of this variety that are thirty years old are affected. It is nearly as serious on the Spitzenburg. The Baldwin is more affected than the Spy, Greening or Russets, but none of these are as badly affected as are the King and Spitzenburg. It seems to be worse on poorly drained land than on good soil.

Cause.—The cause is not definitely known. It is probably sometimes due to winter injury, but this does not seem to account for it in all cases. Whatever the original cause, the wound once made becomes infected by the wood-rot fungi, which cause the trunk to

FIG. 90.—*Collar rot of the King. The same tree as in Fig. 89 with the dead bark removed.*

also on some hardier stock, as the Spy. When we add to this the desirability of each grower selecting his own scions from productive trees, it will probably be well worth while to top-bud or graft.

The planting of the King has almost ceased on account of prevalence of this disease. But it furnishes no reason whatever for abandoning this excellent apple. In the many cases where the Kings were top-

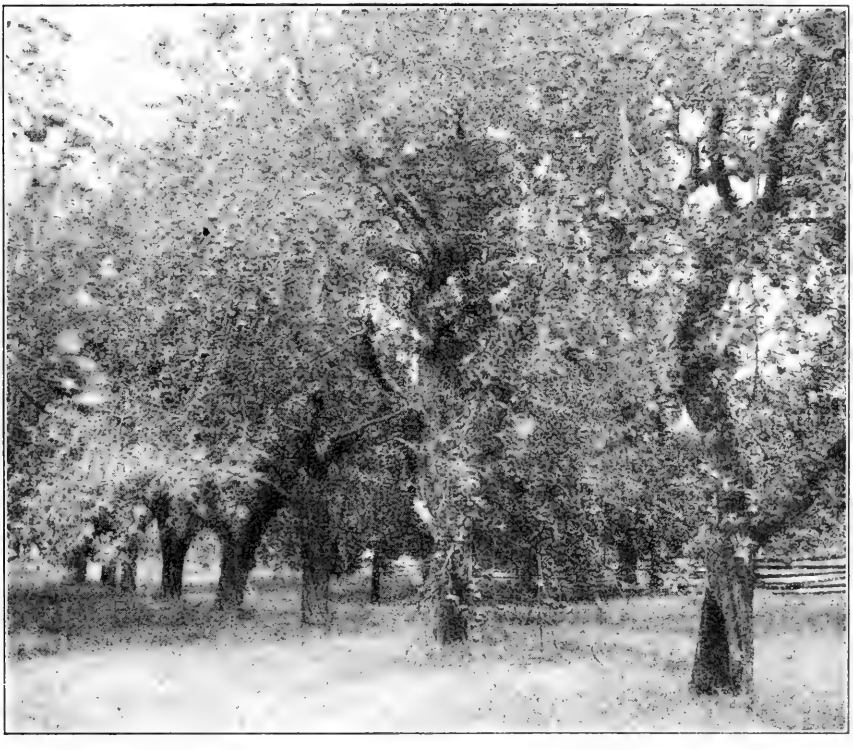

Fig. 91.—*A row of Kings, all affected with collar rot. Dying gradually but surely.*

grafted, as suggested above, there has been no appearance of the trouble, or no more trouble than was usual for the variety of stock on which it was grafted. *In view of these facts, it seems fair to say that no King or Esopus Spitzenburg tree propagated in the ordinary way should be set in Western New York. If these varieties are desired, secure them by top-grafting on some hardy stock.*

FIG. 92.—*Collar rot avoided by top-working on Spy stock.*

CHAPTER XIV.

Yields, Markets and Prices.

Average yields.—The following tables give some of the chief points in the average yields:

Table 37.

Approximate total yield for entire county.

	Bushels.
1899 (U. S. Census report)	1,394,000
1900	4,872,000
1901	672,000
1902	4,053,000

Table 38.

Average yield per acre.

	Trees Set Before 1880.			Trees Set Since 1879.			Average.		
	No. orchards.	Acres.	Average yield.	No. orchards.	Acres.	Average yield.	No. orchards.	Acres.	Average yield.
1899*								19,000	73
1900	171	1,496¾	252	18	190	46	189	1,686¾	229
1901	293	2,041¾	34	25	240	22	318	2,281¾	32
1902	385	2,734¼	222	31	333	74	416	3,067¼	206
1903†							200	1,621¼	265

*The yield for 1899 is for "trees of bearing age" and is taken from the census report.

†The average yield for 1903 is too large for it does not include young trees nor does it include orchards that gave no yield.

Table 39.

Average yield per tree.

Trees set before 1880.	Bushels.
1899 (trees of bearing age)	1.75
1900	5.78
1901	.78
1902	5.01
Average	3.33

This calculation is for the number of trees that the orchards would contain if there were no trees missing.

TABLE 40.

Average number of bushels raised by each grower in Walworth.

	Bushels.
1900	1,700
1901	210
1902	1,200

The three-year-average yield in Walworth township is about thirty-four bushels above that of the entire county. This difference is due to the poorer care given in the remainder of the county, particularly in the southern part.

TABLE 41.

Variations in yields of orchards.

The following table will give some idea of the distribution of yields that produced the averages in 1902, trees set before 1880.

YIELD.	WALWORTH.		REMAINDER OF COUNTY.		ENTIRE COUNTY.	
	No. orchards.	No. acres.	No. orchards.	No. acres.	No. orchards.	No. acres.
0–100 bushels	36	19 1/2	17	38 6/12	53	57 8
101–200 bushels	75	36 1/2	27	41 7/12	102	77 9
201–300 bushels	75	31 2 3/4	28	34 4/12	103	65 7/4
301–400 bushels	46	30 1	11	19 4	57	49 5
401–500 bushels	26	6 7/12	5	5 5	31	12 2 1/2
Over 500 bushels	31	8 5	5	5 3	36	13 8

The largest yield reported for the year 1902 was 1,000 bushels per acre from a four-acre orchard.

Markets—the evaporating industry.—The orchard industry of this county cannot be understood without a knowledge of the evaporating industry. How predominant this industry is can be seen by referring to table 42. The proportion of apples evaporated varies from year to year, being influenced by the quality of the fruit and the relative prices of green and dried apples. Probably seventy-five per cent of all the apples raised in this county during the past four years has been evaporated. A little less than half the evaporated fruit was evaporated by the man who grew it. That which is sold usually goes to some farmer's evaporator. The evaporators are almost as characteristic of the farmyards as are the barns. They also occur in all of the villages, but the largest part of the evaporating is done on the farms. The industry is a rural one and seems likely to remain such for some years.

TABLE 42.

What becomes of the apple crop.

HOW DISPOSED OF.	1900.		1901.		1902.		1903.	
	Bushels.	Per cent.	Bushels.	Per cent.	Bushels.	Per cent.	Bushels.	Per cent.
Evaporated by the grower	90,650	33	12,175	22	191,480	32	160,840	37
Sold to be evaporated	92,641	33	14,094	26	213,643	36	134,319	31
Picked and sold in barrels or in bulk			9,933	18	73,000	12	139,085	32
Part evaporated or sold to evaporate and part barreled, the proportion not given	88,178	32	18,600	34	107,830	18		
Otherwise disposed of	6,000	2			7,950	2	5,392	1

If we apportion the yield that was partly barreled and partly evaporated then the percentage of the crop evaporated would be about as follows: 1900, 85 per cent; 1901, 60 per cent; 1902, 75 per cent; 1903, 68 per cent.

TABLE 43.

Orchards from which the entire crop was evaporated or sold to evaporate—none were hand-picked.

YEAR.	No. orchards.	No. acres.	No. bushels.	Per cent of the total yield.
1900	104	526½	151,700	57
1901	41	329½	17,060	31
1902	288	1657½	316,980	45
1903	113	583	147,830	34

In many cases the fact that the women and children of the household can help in the work, so reduces the expense that the small evaporator can successfully compete with the larger ones.

The evaporating industry furnishes a good outlet for fruit that is not good enough to barrel. It should be encouraged by every possible means. The ease of preserving and the small space into which a bushel of apples can be condensed make this a very desirable way of reaching the cheaper trade in Europe and Asia as well as in our own cities.

A good harvest. Barreled and ready for storing.

Hauling to the depot.

The dried apples occupy only about one-seventh of the space occupied by the green apples from which they came. This makes a great saving in the cost of transportation. The Government can be of great assistance in helping to develop these markets. There should be a good future for the evaporating industry.

But in order to secure and retain this trade the evaporator men must furnish a product that will keep. One of the reasons for the present low price is undoubtedly the result of marketing what has been aptly termed "apple sauce." The stock is not dried sufficiently to keep well. One reliable firm evaporated 52,000 bushels in 1903, which averaged 6.29 lbs. of dried stock per bushel. Their average in 1902 was 6.85 lbs. The average of a number of small evaporators in 1903 was 7.45 lbs.

The number of pounds dried stock that a bushel will give varies greatly with the variety of the apple. Winter varieties average from one-fifth to one-seventh above the fall varieties. Russets give a larger product than Greening or Baldwin. Ben Davis and Twenty Ounce give less than these. The amount is said to vary in different years. But none of these factors account for the difference between 6.29 and 7.45 pounds. If the stock that was dried till a bushel gave only 6.29 pounds was properly dried, what can we say of that which contained 1.16 pounds more water, or what of that where nearly 9 pounds of dried stock were secured from a bushel? The whole subject of evaporating and marketing deserves a careful study.

It would pay to raise better fruit and barrel more of it.—Desirable as the evaporating industry is in disposing of poor fruit, there is little question that it would pay the growers to raise better apples and pick the best for barreling. From a third to a half of the crop, depending on the year, is sold to evaporate without thus selecting the best to barrel, that is, the entire crop is shaken from the trees for evaporating. (See table 43.) This includes a still larger proportion of the number of orchards, in some years as many as three-fourths, for it is more practiced in the small orchards than in the larger ones.

A few growers, particularly in the western part of the county, sell a part of their crop in Rochester to retail dealers or sell it on the streets. This is particularly profitable with apples of extra good quality.

There are a number of secondary markets. One man used 50,000 bushels in 1902 for the manufacture of brandy. The vinegar works

of the American Fruit Product Company at Newark make about half a million gallons of cider and vinegar per year. Many others make smaller quantities of cider and vinegar.

Prices.—Apples for evaporating are sold by the 100 pounds. The average prices and the prices of barreled apples are given in table 44.

TABLE 44.

Average price paid for apples to evaporate per 100 lbs. (2 bushels).

Year.	Price.
1900	$0 30
1901	64
1902	44
1903	41.3

Average price per barrel.

1902	1 75
1903	1 85
Average price per bushel picked apples sold in bulk, 1903	44.2
Average price per pound for dried stock, 1903	.0504

Apples sold on the streets and to grocerymen in Rochester are quite variable in price, but usually bring two to three times as much as when sold to dry.

The vinegar factories pay the lowest price of any market. The 1902 prices ranged from 12 to 20 cents per hundred.

Income per acre.—The average gross income per acre for the entire county from orchards set before 1880 has been as follows: 1900, $37.80; 1901, $14.28; 1902, $48.18. The averages in Walworth township have been considerably better than the average for the county. If these incomes seem rather small, it must be remembered that averages include orchards that have received no care of any kind as well as those that have received the best possible treatment. Unfortunately the average expense can not be obtained, for very few men keep an account of the expense of caring for the orchard. In a very large number of orchards—the ones that lower the average yield and income—there is practically no expense except the use of the land and the expense of hauling the apples to the evaporator. Table 45 will give a better idea of the average income, as it gives the number of orchards for each difference of $10 in income.

TABLE 45.

Average income per acre from orchards set before 1880, entire county.

INCOME PER ACRE.	1900.			1901.			1902.		
	No. orchards.	No. acres.	Per cent.	No. orchards.	No. acres.	Per cent.	No. orchards.	No. acres.	Per cent.
Less than $10	14	121½	10.0	118	670½	44.5	16	105½	4.4
$10 to $19	14	161	13.3	25	276	18.4	33	252½	10.6
20 to 29	16	164½	13.5	29	201	13.4	34	213½	9.0
30 to 39	30	186½	15.4	8	55½	3.7	52	356½	15.0
40 to 49	21	103½	8.5	9	52	3.5	40	277	11.2
50 to 59	23	88	7.3	16	147	9.8	43	230½	9.7
60 to 69	25	134½	11.1	1	8	0.5	22	98	4.1
70 to 79	11	74½	6.2	1	4	0.3	34	175¾	7.4
80 to 89	5	13	1.1	2	22½	1.5	18	138½	5.8
90 to 99	2	6	0.5	.....	.....	.....	16	85½	3.6
100 to 124	9	144	11.1	5	23½	1.6	30	135½	5.8
125 to 149	2	8	0.7	4	33	2.2	18	140½	5.9
150 or more	5	14	1.2	3	12½	0.8	10	169	7.0

	1900.	1901.	1902.
Average income per acre — entire county — trees of all ages	$34 35	$13 44	$44 70
Average income per acre — entire county — trees set before 1880	37 80	14 28	48 18
Average income per acre in Walworth—trees set before 1880	49 50	17 22	52 58
Average total income per grower in Walworth	255 00	88 20	264 00

SUMMARY.

Extent of the Survey.—During the summer of 1903, 574 orchards, containing 3,761 acres, were examined in Wayne county. In 1904, 564 orchards, of 4,881 acres, were examined in Orleans county. The statistics in this report are based on Wayne county. The results from Orleans county we hope to publish later.

Area planted to apples.—There are in Wayne county about 21,000 acres of apple orchards. The total area of improved land in farms is 305,299* acres; or, 6.9 per cent of the improved farm land is planted to apples.

Varieties.—Baldwin and Greening are the leading varieties. Roxbury Russet, King, Northern Spy and Twenty Ounce are also rather extensively grown. The recent plantings have some of these same varieties, but there is a tendency to plant the earlier-bearing kinds.

Rented orchards.—Between twenty and twenty-five per cent of the orchards are rented. The four-year average yield of those managed by the owner has been 210 bushels; of those managed by renters, 174 bushels.

Orchard renovation.—Nearly all of the orchards have been badly neglected, but during the past few years a large part of them have received more attention. Fourteen per cent have been distinctly renovated during the past ten years.

Tillage and yields.—Twenty per cent have been tilled five years or more; 44 per cent have been in sod at least five years; the others have been tilled part of the time. Thirty per cent were tilled in 1903.

The four-year-average yields have been: Tilled every year for at least five years, 266 bushels; tilled most years, 229 bushels; sod most years, 202 bushels; sod at least five years, 148 bushels. Or the average yield of those that are regularly tilled is 80 per cent above that of those regularly in sod. A part of this difference is due to tillage and a part is due to the fact that the man who tills his orchard is likely to give it improved care in other respects. Taking only those orchards that are otherwise well cared for, the difference is reduced to 35 per cent in favor of tillage, the four-year-average yields being: Tilled every year, 271 bushels; tilled most years, 245; sod most years, 206; sod every year, 200.

Of the various methods of sod treatment, pasturing with hogs or sheep

*Twelfth Census Report.

gave better yields than not pasturing or pasturing with cattle or horses; but none of the methods of sod treatment equalled tillage in average yields. A few sod orchards are among the best producers, but the average is much below that of the tilled ones. Liberal applications of barnyard manure reduce the need of tillage.

Very many orchards are in need of more growth in order to place the trees in a vigorous condition. Tillage is usually the cheapest and most effective way of producing this. Barnyard manure may also be needed.

Fertilization and yields.—One-third of the orchards received no fertilization of any kind. The other two-thirds received more or less manure. Probably less than half received enough of anything so as to be classed as fertilized. Commercial fertilizers have been used in about twelve per cent and green manure (cover-crops) in about the same area.

The average yield for 1902 and 1903 of fertilized orchards was 257 bushels; for unfertilized it was 202 bushels.

A few men have shipped in manure from Buffalo. Some have found that they can profitably buy cattle for winter-feeding, and thus secure manure.

Cover-crops.—On most of the soils, humus is needed more than mere plant-food. Barnyard manure or cover-crops usually give better results than commercial fertilizers.

Cover-crops were grown in eight per cent of the orchards in 1903. Buckwheat is the most commonly used. Crimson clover, red clover, rye, large clover, alfalfa, peas and oats, and vetch are also grown.

Pruning.—The ultimate death of most trees is due to neglect of pruning coupled with a type of pruning that is worse than neglect. In sixteen per cent of the orchards, stubs from two to twelve inches long were left. Paint is rarely used on wounds. This treatment causes the trunks to decay and results in a broken tree.

The important points in pruning are: (1) The limbs should be cut close to the trunk. (2) Large limbs should not be removed without cause. (3) Paint should be used on large wounds. (4) Pruning should be done every year rather than give the occasional "thorough trimming."

Spraying.—Thirty-three per cent of the orchards are seldom or never sprayed; 41 per cent were sprayed in 1903.

Spraying gives less profit when fruit is grown for evaporating than when grown to barrel. In 1903 the damages from insects and fungi were small, but in this year the sprayed orchards averaged 27 bushels per acre

above the unsprayed and averaged better in price. The average income per acre from sprayed orchards was $77.84; from unsprayed, $63. In many cases only one spraying was given.

Distance between trees.—A great loss is caused by the trees being too close together. When trees are too close, the lower limbs die and cause a loss not only in the crop, but the dead limbs lead to decayed trunks. In 43 per cent of the mature orchards the trees are 30 x 30 feet or less, the average distance being 31.6 feet. The four-year-average yields have been: Trees not over 30 x 30 feet, 186 bushels; 31 x 31 to 35 x 35 feet, 222 bushels; 36 x 36 to 40 x 40 feet, 229 bushels.

If trees are too close: (1) They are not so healthy. (2) The fruit does not color well. (3) The trees have less bearing surface. (4) Insects and fungi do more damage. (5) The cost of labor is greater.

Orchards should be thinned as soon as the trees begin to interfere, before the lower limbs have been killed. Thinning should ordinarily be accomplished by removing every other row diagonally, first having determined which way will leave the largest number of sound trees.

Age and yield.—The maximum yield in Wayne county seems to come at 44 years after planting. This age will doubtless be greater in the future, for good care seems to give a greater gain in the longevity of the trees than in the yearly yield.

Some orchards planted nearly a century ago are still profitable, but a large number of the neglected orchards that were planted about forty years ago will be of little value in twenty years. In the north part of the county, some young orchards are being planted to meet this contingency.

Drainage problems.—About eight per cent of the orchards need drainage throughout. Thirty per cent need drainage in part of their area. The greatest loss from poor drainage is not in the damage to entire orchards, but in the small undrained places that occur in many orchards.

Fifty-four orchards in Walworth township were reported as needing drainage. These gave 42 bushels less yield per acre than the average of the township.

Poor drainage not only affects the vigor of the tree directly, but it encourages canker, collar rot, etc. Land that is well drained for grain crops may not be well drained for apples.

Soils.—The loamy soils are the best for apple production, but good apple crops are grown on quite diversified soils. The treatment that the

orchard receives is far more important than the kind of soil. This treatment must vary to some extent with the type of soil. A good apple soil in Wayne county may be said to be one that is well drained and deep.

Site and aspect.—The elevation above the surrounding country does not have a marked effect on the yield.

The easterly slopes give considerably better yields than the westerly, probably owing to the strong west winds.

Enemies.—The most serious enemies of the apple are the scab fungus and the codlin-moth. Both of these can be controlled by spraying.

The collar rot or King disease is a rot that kills the bark at the surface of the ground. It is worst on Kings, attacking nearly all the mature trees. It is also bad on the Spitzenburg and occurs to some extent on all varieties. It is usually worst on poorly drained soil. Little can be done except to treat the wounds as any wound should be treated. But the trouble can be avoided by planting hardy stocks, as the Spy, and top-working to King. If this is done, the trouble furnishes no reason whatever for abandoning the King apple.

Canker is a disease attacking the limbs. It is doing considerable damage in one-fifth of the orchards of the county. If the trees had been well cared for, it would seldom have secured a foothold, except in the Twenty Ounce. It can be overcome, except in extreme cases, by pruning out the diseased limbs, spraying the limbs with Bordeaux mixture, and, most important of all, putting the trees in a healthy growing condition.

Evaporating apples.—Wayne county is the home of the apple-evaporating industry. The proportion of the crop that is evaporated varies from year to year, but averages about seventy-five per cent. Some growers pick the best apples to barrel, others shake off the entire crop for evaporating. In 1902 the entire crop was thus shaken from the trees in 45 per cent of the orchard area. A much greater profit would usually be made if the orchard were so managed as to produce a really No. 1 apple, and if more of these were then sold in barrels.

Yields.—The average yields per acre for mature orchards have been: 1900, 252 bushels; 1901, 34 bushels; 1902, 222 bushels.

Income per acre.—The gross average incomes per acre from mature trees have been: 1900, $37.80; 1901, $14.28; 1902, $48.18.

CONDENSED CONCLUSION.

Tillage, fertilization, pruning and spraying are the chief factors that enter into good care of an orchard. One or more of these may sometimes be omitted or poorly done without any serious results. To some extent tillage may replace fertilizers, or vice versa. A thrifty orchard may resist the attacks of disease. Some years there are few insects or fungi, so that spraying is not so much needed. A farmer frequently gets good results from some one of these factors and becomes so impressed with its importance that he makes a hobby of it, to the exclusion of all the others. But the most successful apple-grower is the man who keeps a proper balance between all four agencies and does not expect good care in one respect to make up for neglect in other ways. There is not a recommendation in this report that has not been successfully carried out by some growers; but few men have given attention to all the questions, though some of the most successful have come very near to doing so.

But these factors are not all. The successful man must study; he must learn something of the life processes of the apple-tree; he must know the most serious insect and fungous diseases, and why certain treatment is effective in combating them; he must know something of the drainage, humus and other soil problems.

No set of rules can cover all these points. The apple-grower must go into the orchard and get acquainted with his trees. As one farmer expressed it, he must go into the orchard occasionaly and say to his trees, "Good morning! Is there anything that you would like to-day?" There are many more or less successful farmers who never really see the apple-tree—they see only the crop. Any treatment that will temporarily increase the crop seems to them to be good, but this very treatment may be destroying the prospects for future crops.

Nor is success in orcharding wholly dependent on a large crop. There is a business side to the question. Does it pay to grow cheap apples to be evaporated or to be sold at the lowest market price, or would it pay better to grow a first-class article that costs more and then commands the highest price? A few men in each county are known as growers of good apples. Some other men grow just as good apples and yet have no reputation. Sometimes it is because

their "firsts" and "seconds" all get into one barrel, sometimes it is because the growers are not known. The grower of good apples should establish a business reputation that will bring buyers to him and make a competition for his product.

Last of all, let me urge the advisability of keeping an account with the orchard and with the other important crops (as shown on page 297). See which crops really pay. If the apple orchard proves to be the most profitable crop, then give it first attention.

BULLETINS FOR APPLE-GROWERS.

The most progressive fruit-grower studies his business not only in his own orchard but in every way possible. To keep abreast of the progress made in orchard management he must know what other orchardists are doing and must be familiar with the results of experiment station work. The following are a few of the many free bulletins that are available to New York farmers, so long as the issues remain in print.

The following bulletins are sent free to residents of New York on application to the Cornell University Agricultural Experiment Station, Ithaca, N. Y.:

Bulletin 73. The Cultivation of Orchards.
93. The Cigar Case-Bearer.
142. The Codling-Moth.
153. Impressions of Fruit-Growing Industries.
155. The San José Scale.
170. Tent Caterpillars.
198. Orchard Cover-Crops.
207. Pink Rot, an Attendant of Apple-Scab.
214. The Ribbed Cocoon-Maker of the Apple.
216. Spraying for Wild Mustard and the Dust Spray.
217. Spray Calendar.

Bulletins in the following list are sent free to residents of New York on application to the New York Agricultural Experiment Station, Geneva, N. Y.:

Bulletin 122. The Pistol Case-Bearer.
163, 185. The New York Apple-Tree Canker.
167. A Fruit Disease Survey of the Hudson Valley in 1899.
170. Diseases Injurious to Fruits.

Bulletin 191. A Fruit Disease Survey of Western New York in 1900.
196. Spraying in Bloom.
220. Two Unusual Troubles of Apple Foliage: Frost Blisters; and Spotting and Dropping of Leaves Caused by Spraying.
235. Two Decays of Stored Apples.
239. Thinning Apples.
248. New York Apples in Storage.
258. A Study of the Chemistry of Home-Made Cider Vinegar.
193, 194, 202, 209, 213, 228. San José Scale.

Publications sent free on application to the Secretary of Agriculture, Washington, D. C.:

Soil Survey of the Lyons Area, New York.
Extract from the Yearbook for 1901.
230. Commercial Apple Orcharding.
Extract from the Yearbook for 1902.
266. Top-Working Orchard Trees.
Extract from the Yearbook for 1903.
317. Relation of Cold Storage to Commercial Apple Orcharding.

Farmers' Bulletins.

Bulletin 113. The Apple, and How to Grow It.
127. Important Insecticides: Directions for their Preparation and Use.
146. Insecticides and Fungicides: Chemical Composition and Effectiveness of Certain Preparations.
161. Practical Suggestions for Fruit Growers.
181. Pruning.
187. Drainage of Farm Lands.
208. Varieties of Fruit Recommended for Planting.

PART II.

GEOLOGY OF WAYNE COUNTY, NEW YORK.

W. E. McCOURT.

A characteristic Wayne county landscape.

CONTENTS.

FOREWORD.

It seemed important at the outset of this new orchard enterprise that a study of the geology of the area involved should accompany the examination of the orchards. This part of the investigation was placed in charge of Mr. W. E. McCourt, Fellow in the Department of Geology, and prosecuted by him with vigor and intelligence.

The salient features of the geology of the region are presented in the following pages.

While it is probable that in making future studies of orcharding regions we shall not find it necessary to separate the geology from the soil studies, yet I am pleased in this instance to supplement Mr. Warren's admirable report with such an eminently satisfactory review of a subject generally fundamental and essential.

JOHN CRAIG,

Professor of Horticulture, Cornell University.

INTRODUCTION.

The field-work extended over two months during the summer of 1903. Much detail must, then, be omitted from this report because of the extent of the area examined and the briefness of the time occupied in studying it. Acknowledgment is due Mr. G. F. Warren of the Cornell University College of Agriculture for some of the photographs. I am indebted to Prof. J. A. Bonesteel of the Bureau of Soils for reading the manuscript, and I am especially indebted to Prof. R. S. Tarr of Cornell University, whose kindly suggestions and criticisms have been a great help in the work. The general bearing of the survey in its application to apple-growing was directed by Professor John Craig, of the Department of Horticulture.

TOPOGRAPHY.

Wayne county is a part of what is technically called the Lake Plain, which rises from a level of 247 feet at the lake shore to 580 feet at the escarpment of the Helderberg limestone farther south. Wayne county is about 34 miles in length and averages 18 miles in width, the eastern part being 22 and the western 14 miles. It has been said that the area is part of the Lake Plain, with a gradual rise from north to south. This, however, is not a continuous rise, for the topography for the most part is broken up into remarkably parallel hills. These hills are what geologists call drumlins. A drumlin is a symmetrical hill made up of compact till, this till being a deposit formed by a great ice sheet which at one time covered that section. The coming of this great mass of ice and its effects will be discussed in a later paragraph. The section is a most interesting one, for it lies in this great drumlin belt of New York State, thus furnishing to the student of glacial geology ample opportunity to study one of the most interesting and much-discussed problems in his subject.

From Union Hill to Sodus, at an approximate distance of from four to five miles from the lake shore, is an almost continuous gravel ridge upon which the Ridge road is built and along which the tracks of the Rochester and Sodus Bay Electric Railway Company are laid. North of this ridge the topography is quite level. South, however, it is broken up into the drumlins. Fig. 100 is a photograph taken from the Rome, Watertown and Ogdensburg Railroad at Ontario Center, and shows the level-

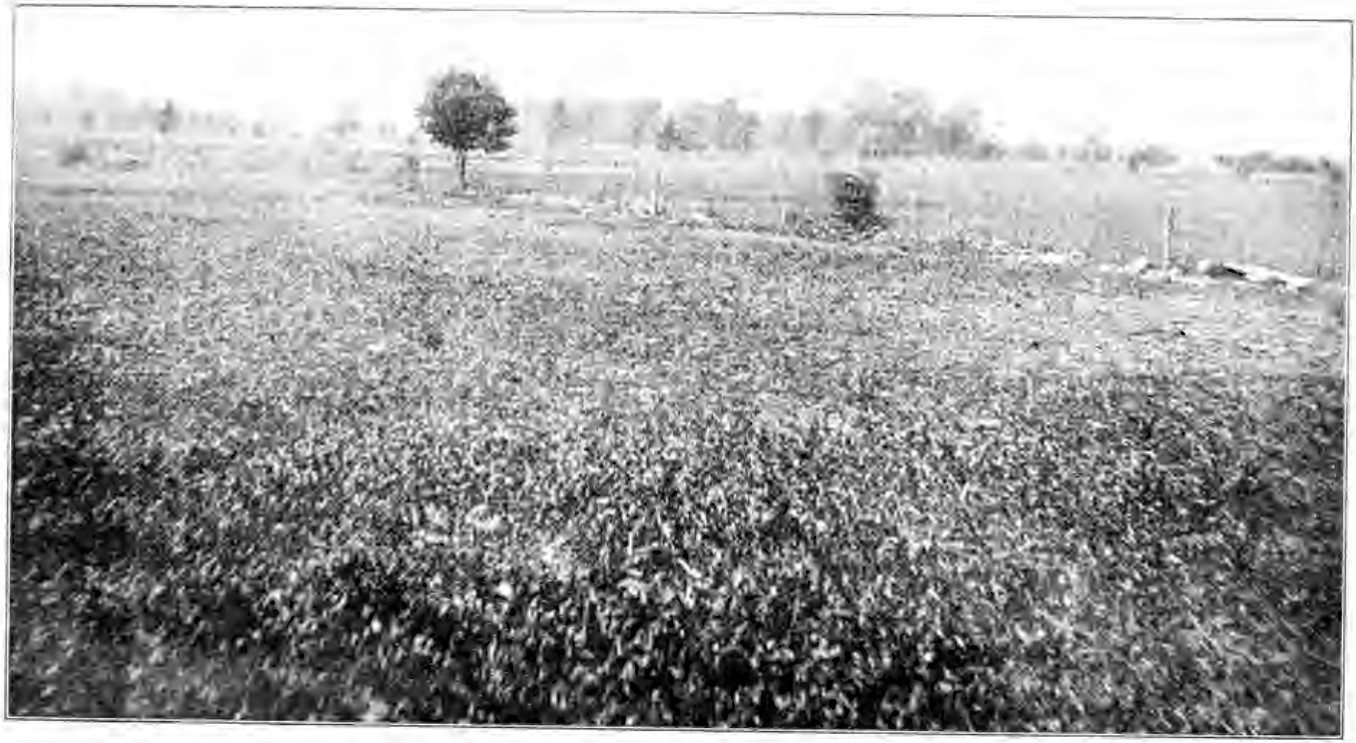

FIG. 100.—*Looking northwest from railroad at Ontario Center, showing level country north of the ridge.*

ness of the country north of the ridge. Fig. 101, taken west of Marion, shows the hilly or drumlin country south of the ridge. The central part of the county is quite level, as is shown in Fig. 120, which was taken southwest of Rose. To the east again we find the drumlins.

The usual boldness of the lake shore is broken by four bays—Blind Sodus, Port, East and Great Sodus. Great Sodus Bay, situated a little to the east of the center of the county, has a length of about three miles and an average width of about two, and contains three islands—Eagle, Little and Long. This bay is almost closed by a sandbar (Fig. 141). The other three bays are entirely closed by bars.

Extending across the southern end of the county is an old river-course, once the bed of an outflow of a glacial lake formed when the ice, which

Fig. 101.—*View near Marion, looking south, to show the rough topography south of the ridge.*

at one time covered the northeastern portion of our country, was retreating.

There is only one river of any considerable size in the county, and it flows in a winding course across the southern part. It is called Ganarauga or Mud Creek until it joins the outlet of Canandaigua lake, when it becomes the Clyde river. It unites with the outlets of Seneca and Cayuga lakes at Montezuma, then assuming the name of the Seneca river. After draining Owasco, Skaneateles and Onondaga lakes it joins the outlet of Oneida lake to form the Oswego river, takes a northerly course and empties into Lake Ontario. All the other streams are small, with the divide occurring south of the ridge.

Small marshes are numerous between the hills and bordering some of the streams. The Montezuma marshes cover about ten square miles in the southeastern portion of the county.

STRATIGRAPHY.

The rocks underlying the area and outcropping at various places are all of the Silurian system. Rock may be said to be close to the surface north of the ridge and for a distance of one or two miles south. In the drumlin region, however, the material covering the rock, which is called drift, is thick; but bed-rock is found close to the surface in some of the lowland regions.

The following table shows the kind of formations found in the county. These will be described in later sections.

Silurian Period	Onondaga or Salina group	Shales and gypsum beds.
	Niagara group	Shales and limestone.
	Clinton group	Shales and limestone containing bed of fossiliferous iron ore.
	Medina group	Sandstone.

Fig. 102 is a photograph of a portion of the New York State geologic map, showing the general relations of the underlying rocks in Wayne county. These are all of sedimentary origin. Sedimentary rocks are laid down in a horizontal position, one layer on top of the other, but by later disturbances they may be tilted or folded. The reason for this succession of rock outcrops is that these rocks have been gently tilted in a southerly direction and also have been planed off diagonally.

The hatched portion bordering the lake shore represents the extent of the oldest beds—the Medina sandstone; the darker portion south of it, the Clinton series; the lighter succeeding portion, the Niagara series, and the grayish area, the Salina series.

MEDINA SANDSTONE.

These sandstones are red or variegated and occur in a narrow band bordering the shore of the lake, widening out farther west into a broader band. They are exposed in some places along the lake front, although there are no cliffs of rock. The color of the sandstone in some places is of a greenish-gray. This is probably due to the fact that "the coloring matter is less diffused or the deoxidizing effect has been more efficient."*

A rather interesting sight in the northern part of the county is the number of schoolhouses and dwellings built of cobbles of Medina sandstone.

*Hall. Geology of the Fourth District, N. Y. 1842, p. 42.

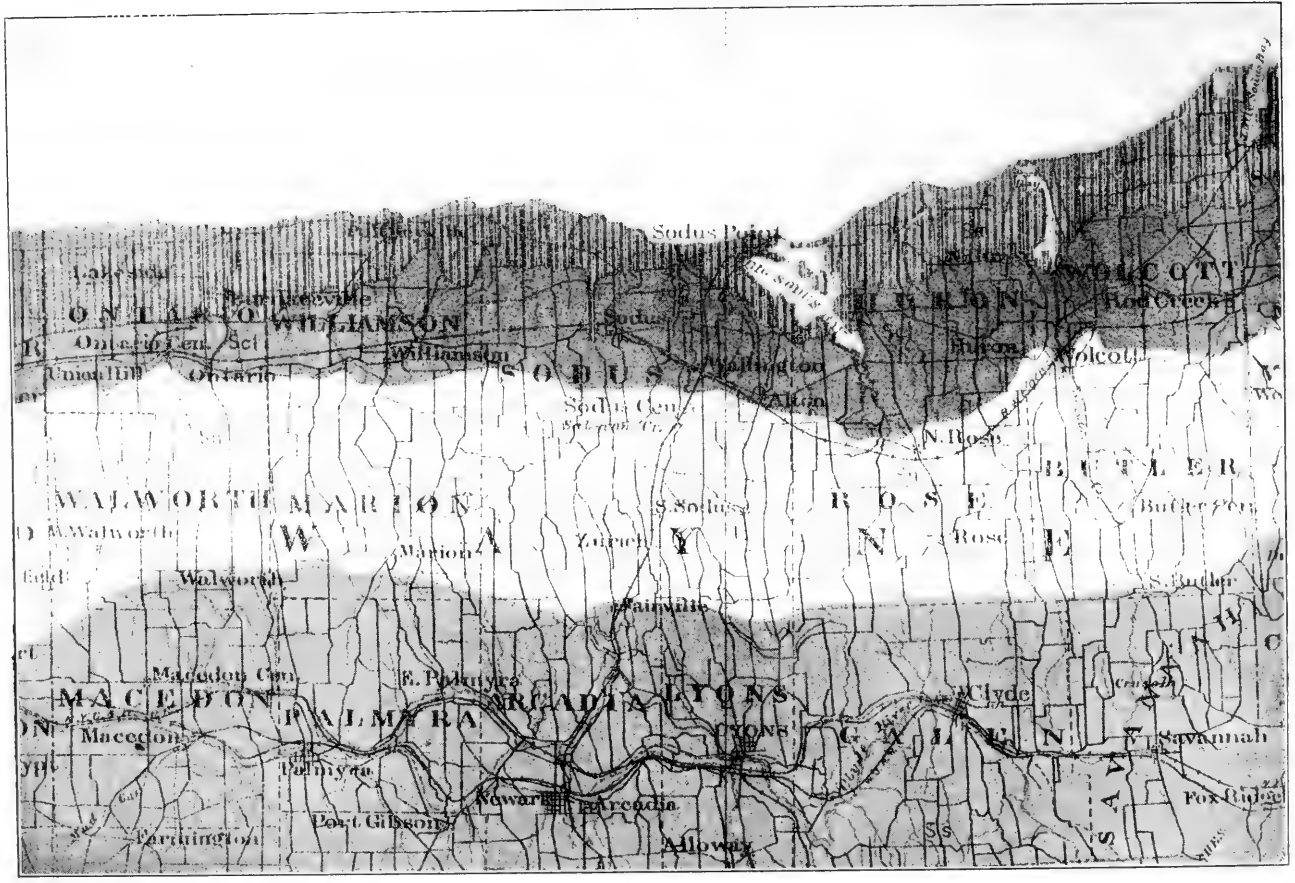

FIG. 102.—*Part of the New York State geologic map, showing the underlying rocks in Wayne county. Hatched portion along lake, Medina series. Dark-portion below, Clinton series. Light portion following, Niagara series. Gray portion at bottom, Salina series.*

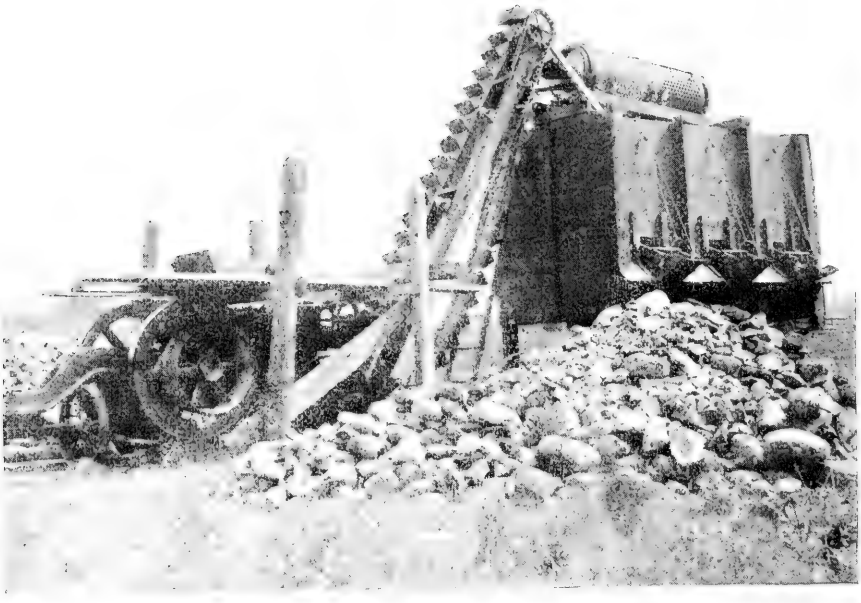

FIG. 103.—*Stone-crusher in position to grind up, for road material, stones collected from the glacial drift.*

FIG. 104.—*Overburden of shale, limestone and drift in iron-working at Ontario.*

These cobbles vary from three to five inches in diameter and were collected along the lake shore, which is thickly strewn with them.

A few houses of this kind have been built from the cobbles collected from the glacial drift; but these stones are used for the most part for fences, or are ground up for road material. Fig. 103 shows a stone-crusher.

FIG. 105.—*Quarry in Niagara limestone, two miles south of Sodus Center.*

CLINTON GROUP.

This group is made up of clay rocks, or shales, and limestones. The shales are of a greenish-gray color, thinly bedded, more green when fresh and more gray when weathered. The limestone is of two kinds, a thinly bedded impure variety and a crystalline and more massive variety. These beds occur in no regular order of succession, but in between layers of shale we find beds and layers of limestone.

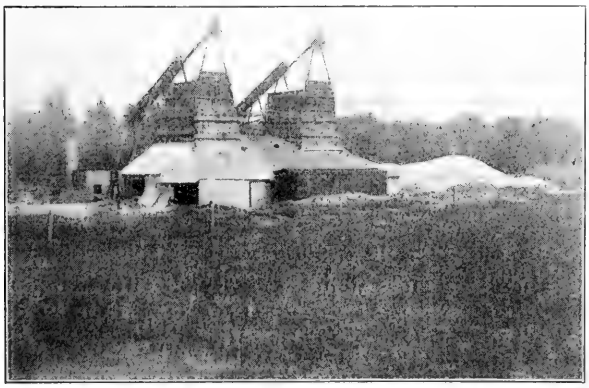

FIG. 106.—*Kiln connected with quarry in Fig. 105.*

About two miles from the lake, and running approximately parallel to it, is a thin bed of fossiliferous hematite, known as the Clinton iron ore. There is an iron mine about one mile north of Ontario. Here the ore bed is covered by an overburden of thinly bedded shale and

limestone ten feet thick, which is in turn overlain by drift to a depth of about six feet. Fig. 104 shows this overburden at Ontario. The bed itself is from two to three feet thick and the ore contains about 33-35 per cent iron. The ore bed at Wolcott is of this same formation.

NIAGARA GROUP.

This is made up of two groups; a lower one of thinly bedded shales and impure limestones and an upper one of hard crystalline limestone. West of the county the limestone stands out as an escarpment or ridge, because of its resistance to the wearing effect of weathering and erosion, but in the county this escarpment is not pronounced. The shales and limestones are of a bluish or grayish color, depending upon the amount of weathering they have undergone. Where the limestone outcrops, the rock is much weathered and contains many cavities due to this weathering. The line of outcrop is marked throughout the county by a series of quarries and lime-kilns. Figs. 105 and 106 show a quarry and kiln located about two miles south of Sodus Center. The limestone is also used to a limited extent for firestones and building stones.

SALINA GROUP.

This group is made up of shales, some limestone and gypsiferous beds. The shale is of a grayish or reddish color, which in many places has weathered to a sticky grayish or reddish clay. Gypseous marl, according to Hall, is found in places along the Erie canal; it usually contains a fair amount of lime, but in many places it is clayey. Salt springs are found bordering the Montezuma marshes, especially at the western end.*

CLIMATE.

Detailed study cannot be expected in a paper of this kind, but we can, from various sources, collect facts which show that climate is of great influence in fruit growing.

The lake is no unimportant agency in modifying climate. R. S. Tarr, in his Geological History of the Chautauqua Grape Belt† says of Lake Erie, and the same will hold true for Lake Ontario: "In the

*Geology of the Fourth District, New York. 1842.

†Bull. 105, Cornell Agr. Exp. Station, 1896, p. 120.

spring, by reason of the low temperature of its waters, it holds back the vegetation and this tends to keep it behind the ordinary frosts. Its very presence checks frost by moderating the temperature of the neighboring air. In the summer the water tends to cool the air of the day and to keep the nocturnal temperature fairly high. During the fall the water has been warmed by the summer sun, and the influence of this warm body of water lengthens the growing season and tends to keep off the early autumn frosts."

E. T. Turner, in his chapter on the climate of New York in Tarr's Physical Geography of New York State,* says, "The surface of Lake Ontario averages from 10 to 15 degrees warmer in winter and cooler in summer than the adjacent land areas; hence the northwesterly winds of winter in passing over the lake are raised to a temperature considerably higher than obtains on the north shore. This influence is felt throughout the portions of the State lying to the south and east of the lakes, although decreasing rapidly as we proceed inland." Continuing, he says, "The southern shore of Lake Ontario has an average midwinter temperature of 5 degrees higher than that of the northern shore. It thus becomes possible in our lake district to raise peaches, grapes and the tender vegetation which can scarcely exist in the adjacent portions of Canada, nor even in the southern interior of the State."

Following is a table compiled from the climate and crop report of the New York section of the Weather Bureau, showing dates of killing frosts in 1902:

Killing Frosts.

LOCATION.	Last of spring.	First of fall.
Lyons	May 11	October 17
Oswego	May 10	October 17
Rochester	May 11	October 10
Wolcott	May 14	October 10

Killing frosts rarely occur before the middle of October, and the latest date in the spring is somewhere about May 10.

The stations in the table are taken as fairly illustrative of the climatological conditions of the county, for Lyons represents the in-

*N. Y. 1902, pp. 338, 350.

land area; Oswego about fifteen miles east of the county and Rochester about fifteen miles west, both represent the lake conditions; Wolcott, too, in the northeastern portion of the county is truly representative.

The following table was also compiled from the Climate and Crop Report for 1902, and shows the average monthly and annual temperature and precipitation for Lyons, Oswego and Rochester:

MEAN MONTHLY AND ANNUAL TEMPERATURE AND PRECIPITATION.

MONTH.	LYONS.		OSWEGO.		ROCHESTER.	
	Temp. °F.	Prec. in inches.	Temp. °F.	Prec. in inches.	Temp. °F.	Prec. in inches.
January	26.5	2.61	24.3	2.97	23.9	3.14
February	25.6	2.36	24.6	2.54	24.4	2.73
March	32.5	2.62	30.4	2.62	30.3	2.86
April	46.3	1.49	42.3	2.08	43.5	2.48
May	57.5	3.15	54.0	2.83	56.3	3.34
June	67.5	3.21	64.0	3.40	66.4	3.22
July	70.5	3.27	69.0	3.12	70.4	2.97
August	69.4	3.57	68.2	2.64	68.4	3.06
September	62.7	2.77	61.7	2.80	62.0	2.34
October	51.1	2.40	50.0	3.26	49.6	2.92
November	40.1	2.92	38.5	3.37	37.4	2.85
December	31.1	2.76	29.4	3.39	28.6	2.91
Year	48.4	33.13	46.4	35.02	46.8	34.82

This table explains itself. While the amount of rainfall is fairly uniform there was greater precipitation during May, June, July and August.

GEOLOGICAL HISTORY OF THE REGION.

At one time the northwestern portion of our country, besides parts of Europe, was covered by a great mass of ice, a vast continental glacier, hundreds of feet thick, in some places even reaching a depth of over a mile. Why it came need not concern us, for the fact that it did come is a geological fact. Labrador was the center of the ice formation of northeastern America. Local glaciers in the Laurentian mountains united to form a much-lobed ice sheet. The motion of the ice was due to a constant accumulation at one center. Before the ice came the topography was in its larger features the same as it is now, but the minor features were much modified and are now much different from what they were. The mass of ice advancing and retreating over the country formed deposits, changed the drainage in some places, caused

the formation of lakes in some places and probably in places did much work of erosion.

By a change in climatological conditions the ice began to retreat "rather rapidly but intermittently." At its farthest point of extension, which was on a line through New Jersey, Pennsylvania, Ohio, etc., a terminal moraine was built by the accumulation of material carried by the ice and dropped at its melting front, thus forming an irregular deposit of hills and mounds of glacial drift. In its retreat, if the ice stopped long enough, other morainal deposits were formed.

The ice, wearing off fragments from the rock and soil over which it passed, dragged them along under itself, carried some in itself and perhaps on itself. These fragments in the lower part were constantly undergoing a grinding action. Some were ground to a flour, others were scratched and had their corners rounded. If you look into a cut in a drumlin or even examine the stones in the fields you will find these scratched and rounded stones. When the ice began to melt back some of this material was dropped, thus forming a covering or layer of till, or boulder clay as it is called. The drumlins are made up of this till. They were probably formed by an unequal deposition of the material because of variations in ice currents. Or perhaps they were formed by the erosion of a layer of till caused by a readvance of the ice.

Streams flowed on the ice, in tunnels in the ice and under the ice. These carried sediment, grinding and wearing it to form gravel and sand. Deposition in these streams and melting of the ice would form what are known as eskers, or ridges of gravel and sand. A stream issuing from the ice to spread out over a more or less level area would form an overwash plain. The deposit formed by the issue of a subglacial stream into a lake might form a hill-like irregular deposit of stratified material called kames. Or these might have been formed in caverns under the ice or by water falling down through crevasses in the ice and depositing its burden.

As the ice kept retreating great changes took place in the drainage. North-flowing streams were blocked against the ice-wall, and this water combined with the water from the melting ice formed marginal lakes. Valleys were filled with drift, new stream courses were formed, resulting in the cutting of gorges and the formation of waterfalls.

The history of the Great Lakes is an interesting and exhaustive study in itself. A brief summary will not be out of place here, for in our

region we have a very good opportunity for a study of one of the stages in the development, namely, the presence of the ridge which has been mentioned before and which marks the shore of a glacial lake. The Great

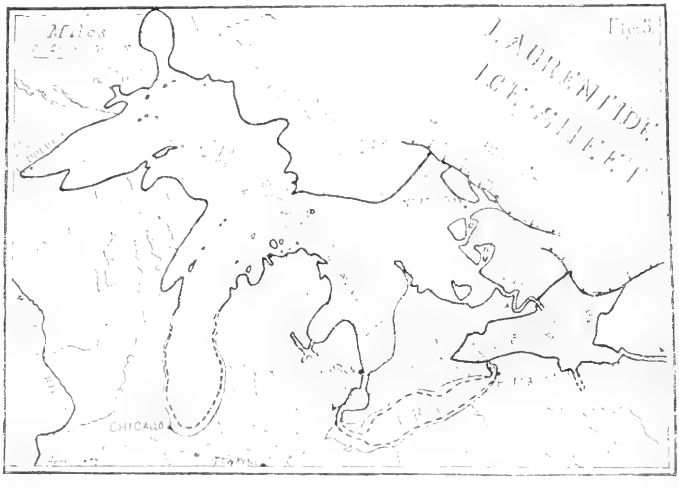

FIG. 107.—*Taylor's map, showing Lake Algonquin emptying into Lake Iroquois through the Trent river.*

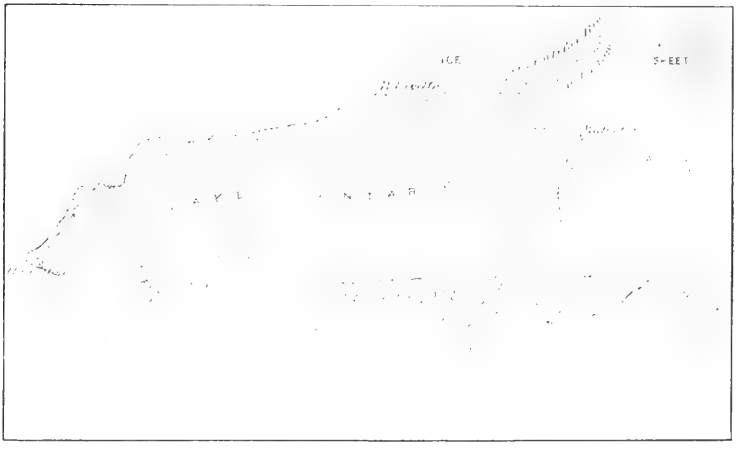

FIG. 108.—*Gilbert's map of Lake Iroquois.*

Lakes probably did not exist before the ice came—before that period which is called the glacial period; but their site was occupied by stream channels.

Along the ice front, as it was retreating, small lakes were formed, the water being supplied by the damming up of north-flowing streams, the melting of the ice and the precipitation. These united to form large lakes. When the ice stood across the northern part of the State there was a large glacial lake, called Lake Newberry, in front of it, with an outflow over the Seneca Lake divide. The ice retreated farther and the lake became quite extensive, its level was lowered and the waters found an outflow past Chicago. This lake is known as Lake Warren. The farther withdrawal of the ice and the continued withdrawal produced other changes. "With the uncovering of the Mohawk, the Lake Warren waters flowed eastward and the level fell, until finally the entire Erie basin was uncovered. Niagara river then began to flow when the water level in the Ontario basin fell below that of Lake Erie. The outflow of the upper Great Lakes was then, as now, through the Detroit-Lake St. Clair channel into Lake Erie; and the Niagara river was then, as now, a large river. The three upper lakes were at that time united to form Lake Algonquin; but, as the ice front withdrew still farther, it uncovered the Trent River valley, which, because of the northward depression of the land at that time, was then lower than the Detroit channel, so that the waters of Lake Algonquin were then withdrawn from the Lake Erie overflow, and the

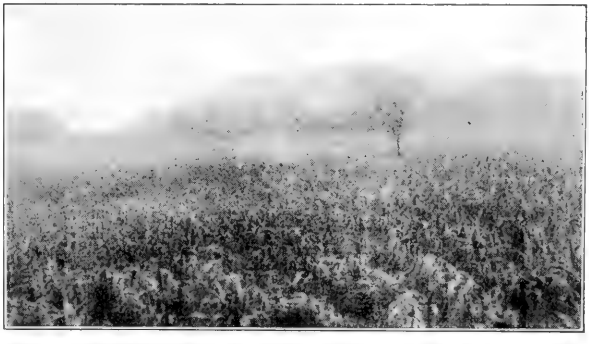

Fig. 109.—*Cliff cut by temporary lake outflow. (Two miles east of Newark).*

Fig. 110.—*Delta formed along temporary lake outflow (east of Newark).*

size of Niagara was greatly reduced thereby (Fig. 107). The waters of the upper Great Lakes then flowed directly into the expanded Ontario without first passing through Erie. The expanded Ontario has been called glacial Lake Iroquois and its overflow was through the Mohawk, because the St. Lawrence outflow was still ice-filled."* Fig. 108 shows this Lake Iroquois as mapped by Gilbert. It was during this stage that the grave ridge through the county was built along the shore line of the expanded lake. Deposits of silt and clay were also formed in this lake, in which some of the drumlins rose as islands.

Just before this stage, however, temporary channels formed outlets from the western lakes to the Mohawk. One of these runs across the

FIG. 111.—*Taylor's map of the Great Lakes while the sea extended up into Ontario.*

southern end of the county. Fig. 109 shows a cliff cut by the water, and Fig. 110 a small delta formed at that time. Further changes took place; with the farther retreat of the ice, Lake Iroquois fell. At this time the land was depressed in the northeast, and the sea encroached upon the Lake Ontario basin, while the upper Great Lakes found an outlet through the Ottawa river (Fig. 111). Then the land began to rise, and finally Lake Ontario assumed its present level. This history is based on the study of the beaches formed by these various lakes during the various stages, by such men as Taylor, Spencer, Newberry and Gilbert, the results of whose careful investigations can be taken as having well established these conclusions.

*Tarr. Phy. Geog. of N. Y. State, p.260.

SOIL TYPES.*

The soil types in the county can be summed up under the following headings:

Stony soils.
Gravelly soils.
Sandy soils.
Loam soils.
Clay soils.
Muck.

This classification, although it differs from the ordinary classification of soil types, is adopted because more simple and somewhat suggestive of their origin.

Stony Soils.

This soil type is typically represented by what is known among geologists as till or boulder clay, namely an unassorted mass of clay, sand, gravel, stones and boulders resulting from deposition from the ice (page 377). The soil is of a more or less clayey nature. The surface soil, however, seems to be more of a sandy loam; but in the few cuts that were seen the subsoil is hard and clayey, being the typical boulder clay. The natural sections along the lake shore in the northeastern part of the county show exceptionally well the character of this hard, compact boulder clay, for the action of the waves and rain have caused this compact drift to stand up in beautiful fantastic pinnacles and spires. Fig. 112 is a photograph of one of these pinnacles in a drumlin three miles east of Sodus Bay. A more distant view is shown in Fig. 130. The soil contains numerous stones, some rounded, some angular and some scratched, showing the influence of ice action. The stones, which make up thirty-five to fifty per cent of the soil, are to a large extent local, that is, derived from the Silurian sandstone, shale and limestone. Gneiss and granite, brought by the ice from the north, are also found, and in some places are erratics of considerable size. From most of the farms, however, the stones have been picked and piled into heaps or built into fences. Some, too, are being crushed for road material.

This soil type occupies by far the largest portion of the county, covering probably about half of the area. The soil areas throughout

*This classification represents the geological method and is not that of the Bureau of Soils presented in Part I.

the county are quite complex, and no definite boundaries can be mapped, but there are general and typical areas which can be described. In general, this type occupies a belt extending across the county east to west, and from the ridge to the southern boundary. The northeastern portion of the county is also occupied by scattered areas of this type. The belt across the section is interrupted in the central portion south of Sodus Bay and extending down to Clyde by an area

FIG. 112.—*Pinnacle of boulder clay in drumlin three miles east of Sodus Bay.*

of other types covering a section of about fifteen or twenty square miles. There is also a strip of another type following the general trend of the New York Central Railroad. The drumlins are included in this type (Figs. 113 and 114). It must not be thought that this type covers exclusively the area outlined, for there are small areas of muck between some of the hills and bordering some of the streams. Clay patches are common in some places, as also are sandy and gravelly areas.

Gravelly Soils.

The name given to this type is suggestive of its character. It is, for the most part, made up of gravel and sand. Just where to draw the line between gravel soils and sand soils is a difficult question, for one

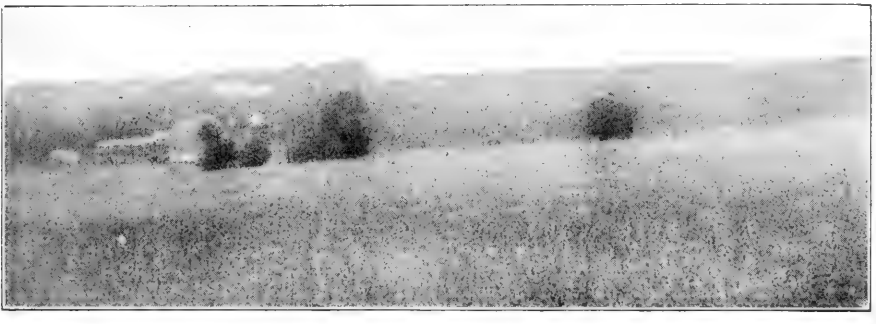

Fig. 113.—*Stony soil. Drumlin four miles northeast of Walworth.*

grades into the other. The name gravelly soils has been given to the type which is obviously gravelly. The name sandy soils has been ascribed to that type which is entirely sandy or contains few pebbles. The pebbles in the gravelly type are rounded, showing that they have

Fig. 114.—*Stony soil. Drumlin three miles west of Marion.*

been worn by water action. They are of the Silurian rocks with a large percentage of gneiss and granite, ranging in size from very small pebbles up to those three and four inches in diameter. The remarkable number of gravel pits throughout the county (Figs. 117, 134 and 136) testify to the good quality of the sand and gravel which is used

for road and building purposes. The areas are somewhat scattered and on the whole do not add up to a very large amount. For convenience of description we may divide them into the following

FIG. 115.—*Gravel soil. Overwash plain two and a half miles west of Marion.*

classes: Overwash areas, kames and eskers, deposits on drumlins, ridge and old stream bed.

Overwash areas.—By an overwash area is meant a deposit of sand and gravel which has been formed by a stream issuing from the front of the ice and depositing its burden on a more or less level area. Fig. 115 shows an overwash area two and one-half miles west of Marion. Another is found northeast of Fairville, and other smaller areas occur in scattered regions. These must have been the seat of deposition just at the close of the glacial period when the ice was retreating.

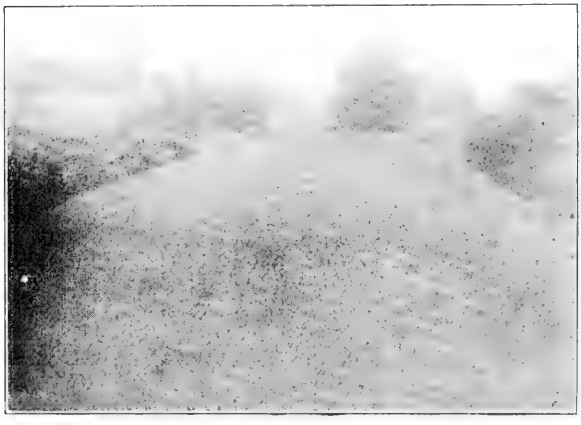

FIG. 116.—*Gravel soil. Palmyra esker.*

Kames and eskers.—A kame area is a collection of hummocky hills enclosing hollows and composed of stratified material, namely, sand and gravel. Fig. 135 shows such an area north of Palmyra. These

areas are of small extent, the best developed one extending from Palmyra north to Marion. These kame areas may have been formed in several different ways—in caverns under the ice, by water falling down through crevasses and depositing its sediment, or where streams from the ice issued into lakes.

Eskers are closely associated with kames, being composed of the same kind of material and probably having been formed by deposition from glacial streams under the thin edge of the ice. An esker is a winding ridge or collection of ridges to which the name serpent kame has also been applied. Two eskers have been studied; one north of Palmyra and extending for a distance of about five miles in a general northerly direction (Figs. 116 and 137); one four miles north of Newark and extending for a distance of one mile (Fig. 138).

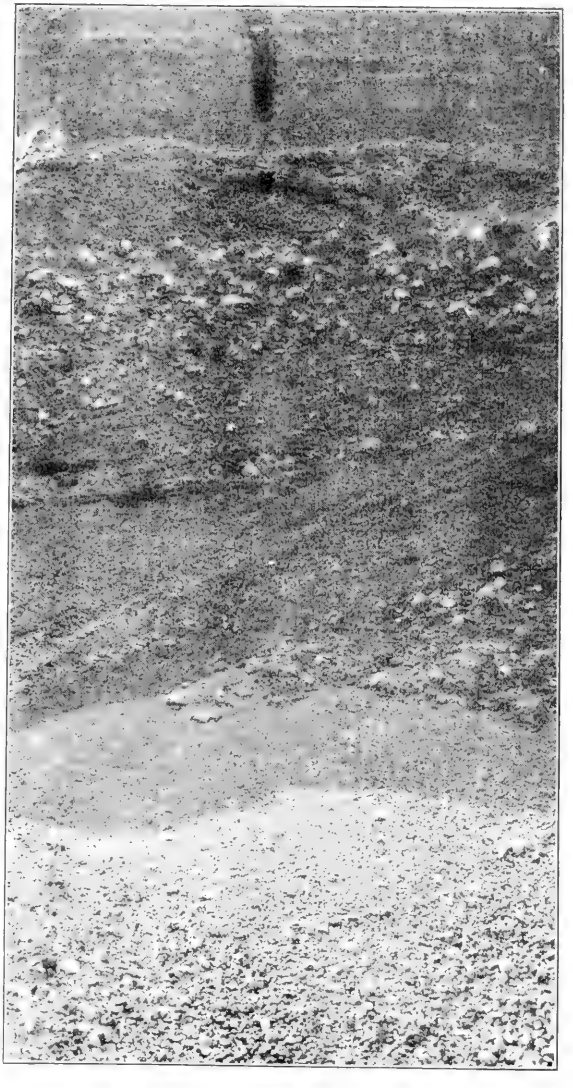

Fig. 117.—*Gravel pit at Perryville.*

Deposits on drumlins.—Associated with the drumlins are masses of stratified drift, usually occupying the lower sides or southern ends.

These deposits on the sides are usually of a rounded, symmetrical shape, some of them having the appearance of being younger drumlins superimposed on older ones, the only chief or vital difference being in the nature of the composing material; the "bumps" being composed of gravel and sand (Fig. 134), and the drumlins of boulder clay (Fig. 131). Fig. 134 shows a cut in one of these gravel areas on the side of a

FIG. 118.—*Consolidated gravel from pit two miles northwest of Lyons.*

drumlin two miles west of Macedon Center. These associated deposits will be considered in more detail in a later section of the report.

Gravel ridge.—This ridge is quite an unique feature in the county and is easily traced as far east as Sodus, where it turns south and becomes less distinct. At this point the exact line of construction is lost, for only patches of it can be found here and there, from which the general direction may be approximately determined. Fig. 108 shows Gilbert's interpretation. This ridge marks the shore line of glacial

Lake Iroquois. The material composing this ridge is quite similar to that in the present lake beach, although some clay is present owing to the weathering of the pebbles.

Following the trend of the railroad through the southern part of the county we find some well-developed gravel areas. Northwest of Palmyra is an area embracing a few square miles. (Fig. 117.) This is being worked by the railroad. Newark is built on a large area of this gravel. Fig. 118 shows some consolidated gravel taken from a pit two miles northwest of Lyons. This line of gravel areas marks the site of an old stream channel mentioned in a previous paragraph.

Fig. 119.—*Sandy soil. Two miles south of Sodus Bay.*

Sandy Soils.

This type is typically a fine sand, although in some places there are some pebbles in the sand. The areas, though scattered, are confined to the northern part of the county. Some of these areas are found north of Ontario, Williamson and Sodus. In fact, scattered sandy areas border many of the streams north of the ridge. Most of these areas are not free from pebbles. These represent stream action, and deposition somewhat like delta formations in the old Lake Iroquois. Just south and west of Sodus Bay is quite an extensive area of this sand which is very fine in texture, and contains very few, if any, stones. Fig. 119 shows some hills of sand south of Sodus Bay. These hills resemble dunes, but they seem too level-topped to be dunes, and the manner of stratification is not the kind which is found in dunes. In sand dunes we

are likely to find confused stratification due to wind deposition, but here the stratification is horizontal. This deposit is probably constructional, although erosion may have made the hills more pronounced. It probably represents a deposit formed by water at the front of the ice.

LOAM SOILS.

The term loam soil is a comprehensive term and conveys a somewhat wide meaning, embracing on the one hand a somewhat sandy soil and on the other a clayey soil. The amount of stones in the soil also varies, some places are entirely free from stones and others contain as high as 30–40 per cent. Next to the stony soils this type covers the largest area

FIG. 120.—*Loamy soil. Two and a half miles southwest of Rose.*

in the county, being well-developed in places north of the ridge, in the northeastern portion of the county and especially in the region around Rose and Alton. In the latter area the soil is quite free from stones and occupies a level stretch of country. (Fig. 120.) In the other regions the soil contains an appreciable amount of stones and occupies more rolling country. This soil owes its origin to Lake Iroquois. In the northern regions the lake waters were not very quiet, hence the variations in texture of the soils. In the central region, however, which represents a bay in the old lake, the water was more quiet, and hence we have the evenness of texture and freedom from stones.

CLAY SOILS.

This type may be subdivided into residual clays and sedimentary clays. The residual clay is a sticky reddish or grayish clay formed as a weathering product of the Salina red and gray shales. In some places the clay

can be seen grading into the shale. The areas are not very extensive, and they are found in patches in the southern part of the county. At places east of Newark, west of Newark and near Palmyra are good examples of this residual clay. Fig. 121 is a view along the Erie canal where beds of this type are found.

The sedimentary clay is of a brownish color, and in some places grades into the loam soil. The area occupied by this subtype is larger than that occupied by the residual clays. Northeast of Clyde

Fig. 121.—*View along Erie canal where patches of residual clay are found.*

is an area embracing about seven square miles. Along the lake shore are patches of this sedimentary clay, especially in the northeastern portion of the county. Here the lake has produced natural sections which show the horizontal stratification of the clay. (Fig. 150.) This subtype was formed in the waters of Lake Iroquois.

Muck.

The term muck is used to designate marshy, swampy and wet areas which, although for the most part scattered, in total reach to quite an acreage. The Montezuma marshes in the southeastern portion of the

county cover an area of ten square miles. Along the Clyde river is another extensive marshy area, and others are found around Zurich, Joy, north of Wolcott and north of Lyons. Other smaller areas of marsh land are found bordering some of the streams and between some of the drumlins. Besides these marshy areas there are many low, wet areas of black, clayey or silty soil, which are found between some of the drumlins.

FEATURES OF GLACIAL GEOLOGY.

Wayne county is especially interesting to the student of glacial geology, in that it shows many phenomena connected with the great ice sheet which at one time covered the northen part of our country.

TILL-COVERING.

The term glacial drift is applied to the aggregations of clay, boulders, sand and pebbles formed directly by ice action or by ice in connection with water action. These are called respectively unstratified and stratified drift. The unstratified drift includes the till sheet, drumlins and moraines, and the stratified drift includes kames, eskers, overwash plains, etc. These two classes are, however, not always distinct, for in an unstratified mass we often find masses of stratified drift. The whole county is covered with drift, either as direct deposits by ice and water or as deposits which have been worked over, so to speak, by some later action.

The till is compact and firm, and the rock fragments it contains are usually somewhat rounded and frequently polished and scratched. The typical form of boulder clay is shown in Fig. 112. The distribution of till bears a close relation to the rate of movement of the ice, depending upon topography and the amount of material dragged or carried by the ice. In some places this till reaches a depth of 100 feet, as in some of the highest drumlins. (Figs. 123, 124 and 125.) In other places, especially in the western and northern part of the county, just south of the ridge this till is very thin. (Fig. 122.) When the ice moved over the country it removed rock fragments from the surface and dragged them along with itself. When it retreated it left this mass of till or ground moraine as it is called. Variations in ice currents and in the direction of ice-flow produced variations in depth, and in some places caused an appearance of stratification.

Fig. 122.—*Till covering west of Walworth.*

DRUMLINS.

As has been said before, Wayne county lies in the drumlin area of New York State. A glance at the United States Topographic sheets of this section of the State will be sufficient to give one a view of the general area of this section, of which Wayne county forms no inconsiderable part. The drumlins are thickest in the central belt of the county, in the townships of Arcadia, Lyons, Palmyra and Marion. In Rose they are almost totally absent, the level topography being broken only by a few "island forms." Farther east, in Savannah and Butler, they are again very thick. North, in Huron and Wolcott, they are not so thickly grouped. In the western and southern areas and in the section south of the ridge

FIG. 123.—*Till covering: Grouped drumlins.*

they are single rather than grouped. North of the ridge there are no drumlins (Fig. 100.) Figs. 123 to 129 show photographs of grouped and single drumlins.

A drumlin is a symmetrical hill made up of compact till. Some, however, contain lenses of stratified drift. They are wonderfully smooth and regular, usually with gently sloping rounded tops. The northern end, commonly, is steeper than the southern end and in all cases the long axis is parallel to the direction of the ice movement. Drumlins are found in our country in New York, New England and Wisconsin.

Form.—The drumlins are both single and grouped, but more often grouped. They vary in size quite considerably. Some are two-thirds

Fig. 124.—*North end of drumlin three miles southwest of West Walworth.*

of a mile long, others are much shorter, even being so small as 300 feet. They vary in height from 25 to 200 feet and the proportion of length to breadth is usually as much as 3 to 1. Some are gently sloping, others steeply sloping; some high and narrow, others, low and flat (Figs. 124 to 128). The north slope is usually steeper than the

FIG. 125.—*North end of drumlin four miles north of Palmyra.*

south slope and the side slopes steeper than the north. There are clearly recognizable certain types of drumlins. A symmetrical type, called by Chamberlain a mammilary or lenticular hill, is one in which the north and south slopes are similar, thus forming an oval, sym-

FIG. 126.—*Side slope of drumlin one mile north of Rose.*

metrical hill. The second type is one in which the north slope is slightly steeper than the south slope. When the southern end is long and drawn out, sometimes so far that the exact termination cannot be distinguished, we have the prevailing type of the Wayne County area. The fourth and last type is one which is intermediate between the

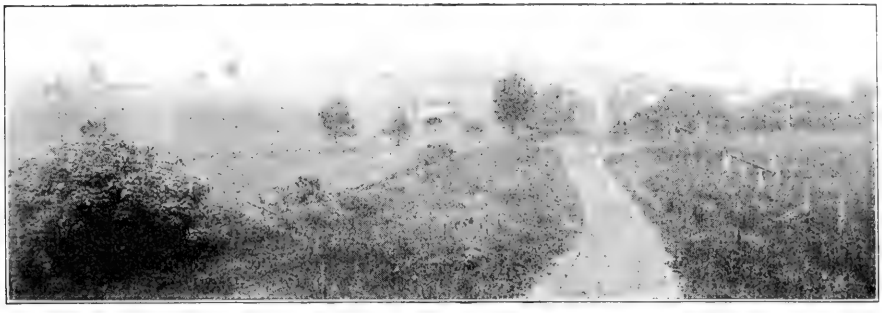

Fig. 127.—*Looking west at drumlin two miles northeast of West Walworth.*

Fig. 128.—*Long, low, flat drumlin.*

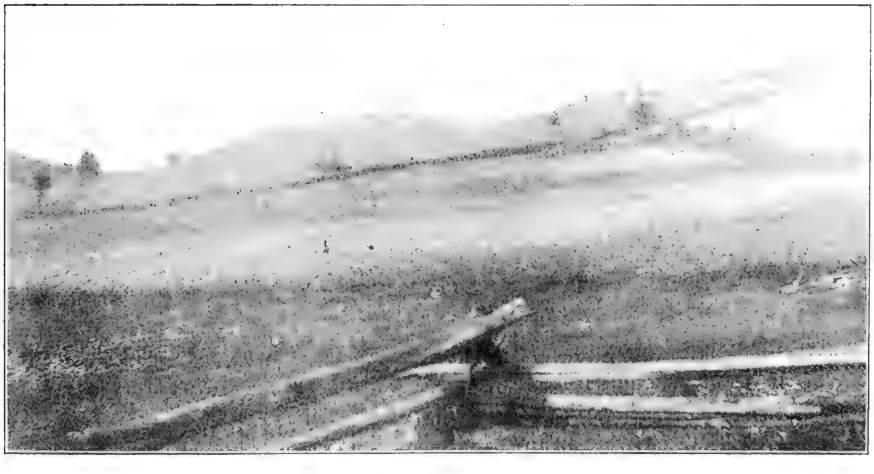

Fig. 129.—*Grouped drumlins.*

second and third. This has been termed the tadpole type by a Cornell student because of its resemblance to a tadpole. In this there is a long tail-like projection hitched on to the body of the drumlin. There are some modifications of these types which are worthy of mention. In some, the symmetry of the drumlin is disfigured by a secondary, smaller hill on the side or at the southern end. This smaller hill is usually of gravel and sand and was undoubtedly formed after the

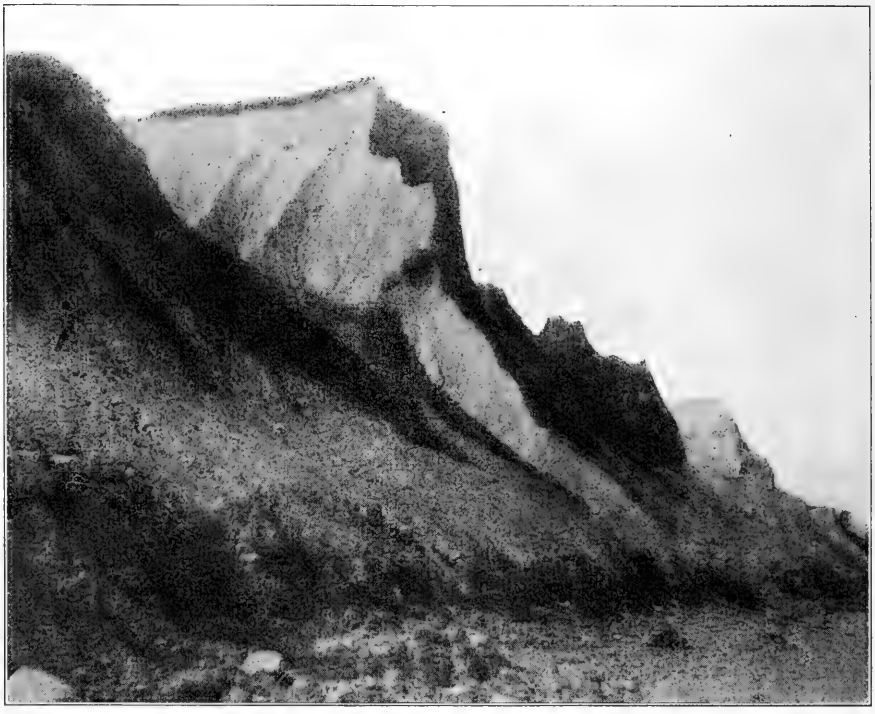

FIG. 130.—*Wave-cut cliffs in drumlin three miles east of Sodus Bay.*

formation of the drumlin. Some drumlins have peculiar and interesting southern endings; a kamy ending is not infrequent nor is an ending in ridge-like gravel deposits. These, too, were of later origin than the drumlins.

Grouped drumlins.—Figs. 101, 123 and 129 show, in a way, how the drumlins are grouped, but a glance at the topographic map will give an idea of the complexity. With all that, however, the grouping is more complex than the map shows. They are placed side by side, end to end and almost on top of each other. The only regularity is in the

uniformity or parallelism of direction, namely to the direction of ice movement. Some of the drumlins, as in Fig. 109, show a scalloping or grooving of the tops and sides. In some cases these grooves are due to erosion, for after a rain one can see little rivulets wearing out these little hollows. In the large majority of cases, however, these grooves represent the original contour of the drumlin as it was formed or at least left after the ice disappeared. There seems to be a grouping of the drumlins into belts at right angles to the direction of ice move-

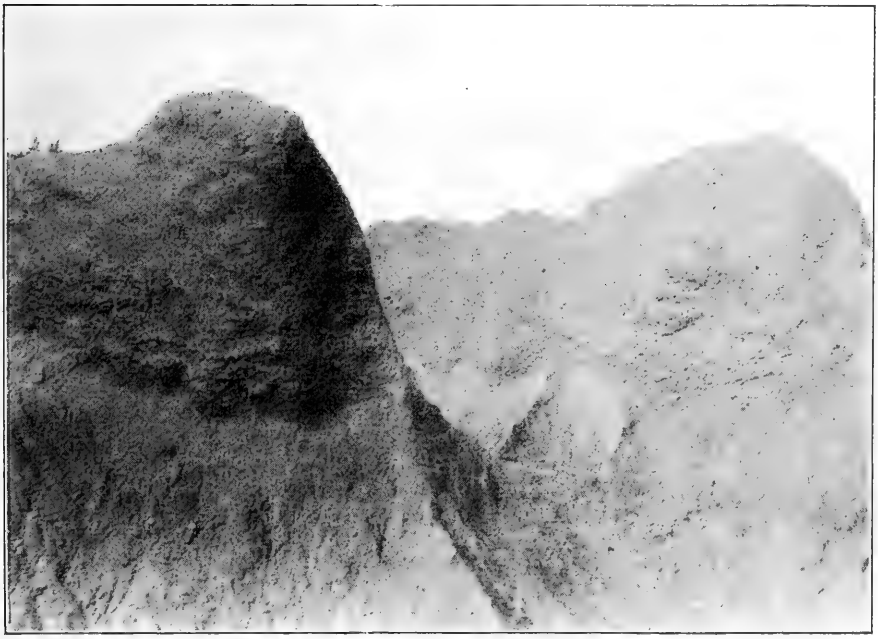

Fig. 131.—*Near view of pinnacle in drumlin shown in Fig. 130.*

ment. The northern belt is made up of single drumlins of the lenticular type; the second of thickly grouped drumlins of the second type mentioned in a former paragraph; the third belt of the tadpole type and the last belt of the type with the long-drawn-out southern ends.

Composition.—The material of which these drift hills are composed is the typical boulder clay containing somewhat rounded, scratched and polished stones. (Figs. 112, 130 and 131.) These stones are largely local, being Silurian rocks, the predominance of each formation being diminished as the drumlins are found farther south from the outcrop

of that particular formation. Granite and gneiss fragments which had been carried by the ice from the north are common. Large boulders or erratics, as they are called, are found scattered throughout the county; these were dropped directly from the ice or deposited by streams flowing from the front of the ice.

In some of the cuts in drumlins along the lake shore are masses of

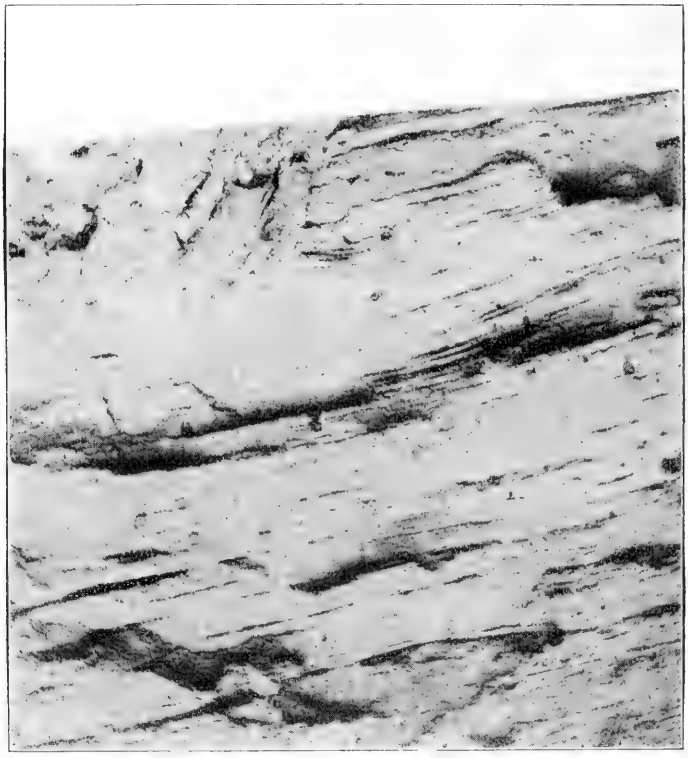

FIG. 132.—*Stratified clay in drumlin at Lake Bluff.*

stratified clay (Figs. 132 and 133). This crumpling shows that there was some pushing after the drumlin was formed. In other cuts are seen lenses of stratified material, sand and gravel. As has been mentioned before, on the sides and at the southern ends of some of the drumlins are hillocks or sheets of stratified material (Fig. 134). Possibly when conditions brought about the retreat of the glacier, numerous streams flowed from the ice-front and numerous marginal lakes were formed and in these waters these deposits may have been made.

The occurrence of eskers and kames indicate, also, that glacial streams were not inactive.

Origin.—The origin of the drumlin has been a much-discussed question. The more probable origin is that—by variations in current or drift supply the ice deposited more material at one point than at another, producing the drumlins by successive additions, in a manner comparable with the formation of a sand-bar in a river.*

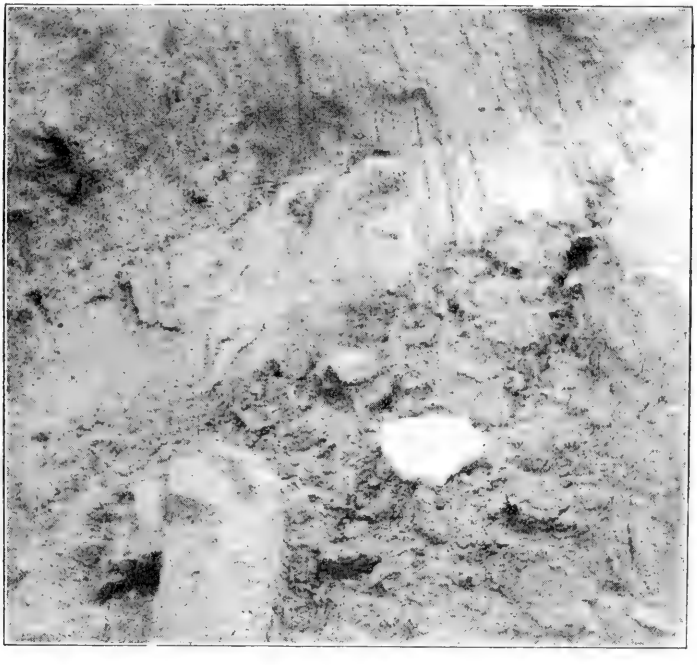

Fig. 133.—*Folded stratified clay in drumlin at Lake Bluff.*

Drumlinoids.

This term is applied to rock hills covered by a veneer of till which have the drumlin outline and which one might, at first glance, classify as drumlins. A study of ice-motion shows that there is a certain rhythm or curve of erosion. Roches montonnées are familiarly cited types of this law of ice-motion to produce rounded lenticular slopes. Drumlinoids are similar results only on a much larger scale. We find some of these northeast of Walworth.

*Abridged from Tarr. Origin of Drumlin's American Geologist, Vol. XIII, 1894, p. 394.

KAME AREAS.

Gerkie describes a kame area as a collection of "mounds and winding ridges, hummocky and undulating like a tumbled sea. The ground now swelling into long undulations, now rising suddenly into beautiful peaks and cones and anon curving up in sharp ridges and often wheeling suddenly around so as to enclose a lakelet of bright, clear water." This description is of a well-developed area. We do not find any such typical areas in Wayne county, but we do find some of a less subdued type. In Marion township they are not infrequent (Fig. 135). They are made up of gravel and sand and were probably formed at the thin edge of the ice by stream action as was described in a former paragraph. Kames are usually associated with moraines. The time was too limited to permit of detailed mapping of the county, but further study will undoubtedly show a belt of moraine running across the county.

FIG. 134.—*Stratified sand and gravel on side of drumlin two miles west of Macedon Center.*

ESKERS.

These form another interesting feature. An esker is a long, narrow, winding ridge or collection of ridges made up of gravel and sand and bearing a very close resemblance to embankments. The drift

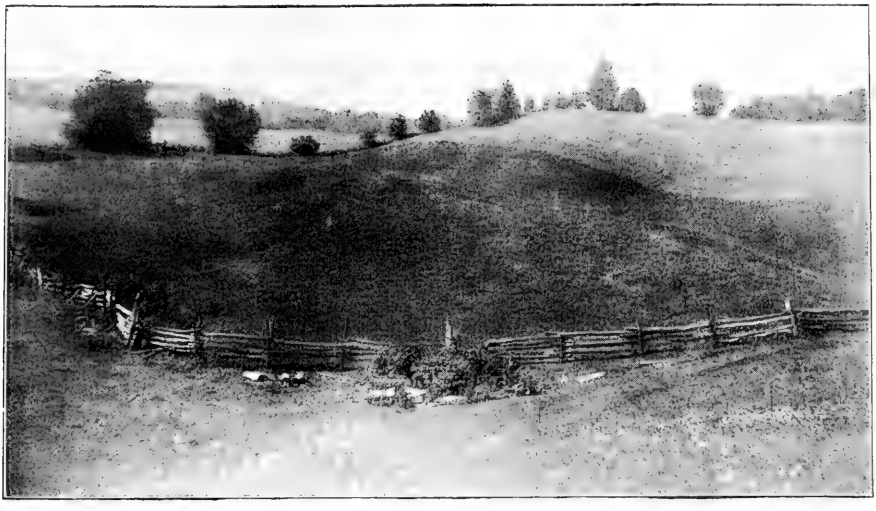

Fig. 135.—*Kame area north of Palmyra.*

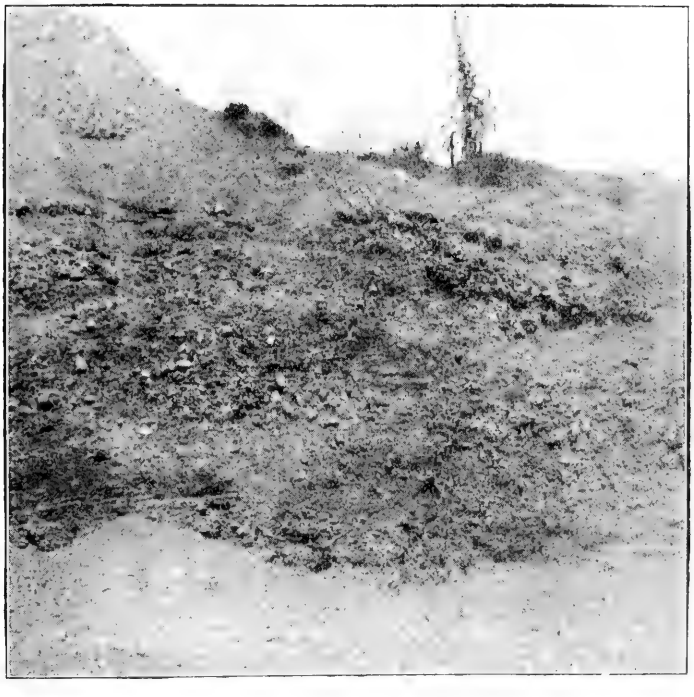

Fig. 136.—*Cut in Palmyra esker.*

shows stratification roughly parallel to the surface outline (Fig. 136). Eskers owe their origin to glacial streams; most probably subglacial streams, although in some cases they may have been formed in supergiacial or englacial streams. When the ice retreated these stream-deposits were left in the form of ridges. In the study two eskers were

FIG. 137.—*Palmyra esker.*

mapped, one north of Palmyra, and the other north of Newark, beginning near Hydeville. Following are descriptions of these two eskers:

Palmyra esker.—This is about four miles long, extending in a general north-south direction between Marion and Palmyra. It has an indistinct, low northern end, then takes two indistinct and broken courses

FIG. 138.—*Hydeville esker.*

for a distance of one-half mile when the two unite to form a pretty little kettle-hole. It continues for one-half mile in a pronounced ridge, then becomes indistinct again; again takes on the form of a ridge and further is lost in a kamy area. Beginning again as a low ridge it gradually becomes better developed and continues for a distance of

a mile or more in a well-defined ridge, to be lost in the levelness of the country. The base at its widest point is 50 feet and the highest point is 40–50 feet. Figs. 116 and 137 are photographs of this esker.

Fig. 139.—*Long Island from Lake Bluff.*

Hydeville esker.—Fig. 138 shows a portion of this small esker, which begins about one and one-half miles north of Hydeville and extends for a mile in a general north-south direction. It begins in an indistinct ridge but soon assumes quite a distinct type and continues as

Fig. 140.—*View from Nicholas Point looking north across Sodus Bay.*

such for one-half mile, where there is an abrupt break, leaving a channel about 35 feet wide. It begins again in a kamy area, and after continuing for one-half mile is lost in a level area. The highest point is 35 feet and the greatest width about 50.

OVERWASH AREAS.

These have been mentioned under the discussion of gravelly soils (Fig. 115). Streams flowed out from beneath the ice, burdened with a great mass of material collected from the overloaded, thin edge of the glacier.

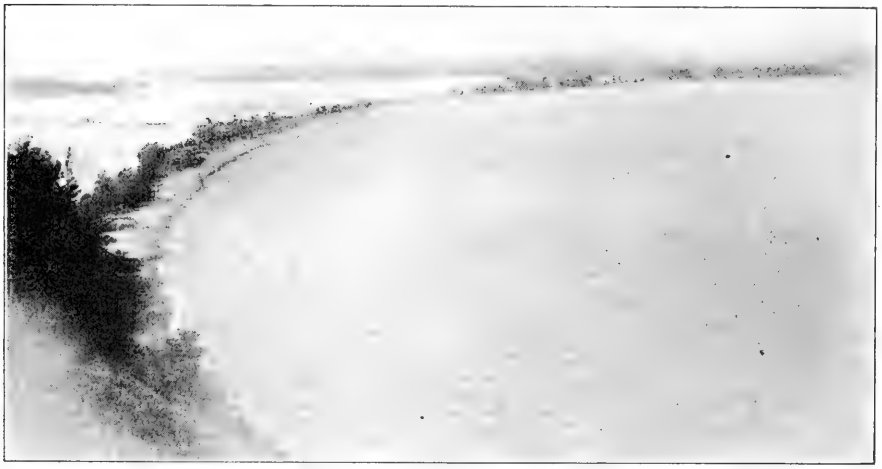

FIG. 141.—*From Lake Bluff looking west showing the bar across Sodus Bay. Charles Point is on the extreme right of the picture.*

The water, now being unconfined by an ice channel, spread out and deposited its burden in the form of a plain. The southward slope of some of these plains indicates the direction of flow of the waters.

FIG. 142.—*Sand hills at Sodus Point.*

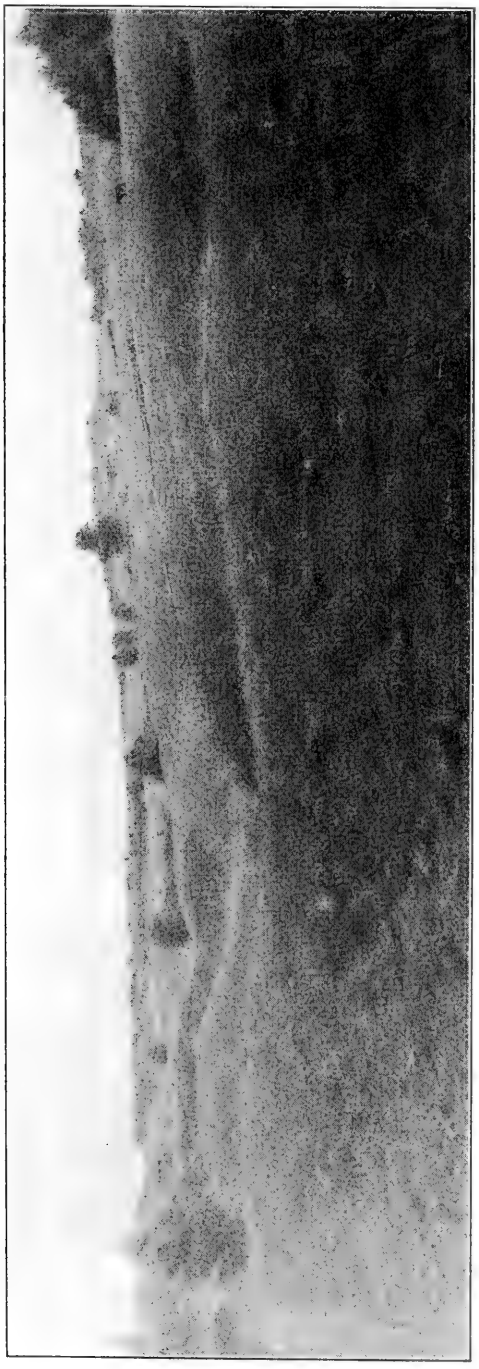

Fig. 143.—*Sand hills two miles northwest of Wallington.*

PRESENT LAKE SHORE.

The evenness of the lake shore is broken by Great Sodus, East, Port and Blind Sodus bays, across all of which, and entirely closing them, excepting Sodus Bay, are sand-bars formed by a checking of the waters carrying sediment to the lake and a consequent settling of the material. Figs. 139 and 140 are views of Sodus Bay, and Fig. 141 shows the bar which almost entirely closes it. Figs. 142 and 143 show the sand hills around Sodus Bay, which were described under sandy soils.

FIG. 144.—*Shore north of Ontario.*

The shore-line varies in different ways. In some places we find larger pebbles than in others, in some places more pebbles than in others; in other places the beach is almost entirely made up of sand; in some places it is higher than in others. These variations are due to variations in wind, supply of sediment, wave action, seasons, and the protection of the shore by jutting forelands. In some places the lake is cutting back into hills, forming cliffs along the shore with a narrow beach at their bases (Fig. 130). In other places it is forming a beach in front of a low area. In short, it is building a continuous beach although varying from place to place. In the bays there is no

such continuous beach, for the action is not so great as along the exposed lake shore. Fig. 144 shows the beach west of Sodus Bay and

Fig. 145.—*Shore three miles east of Sodus Bay.*

Fig 145 is a near view, illustrating the character and form of the pebbles due to the grinding and rolling action of the lake waters.

Where a cliff is being cut the usual contour is shown by Fig. 146.

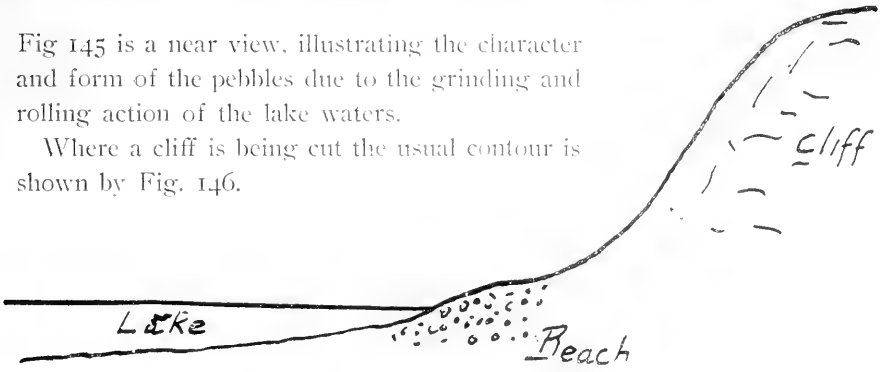

Fig. 146.—*Beach being formed at base of cliff.*

Fig. 147.—*Beach being formed in front of a low area.*

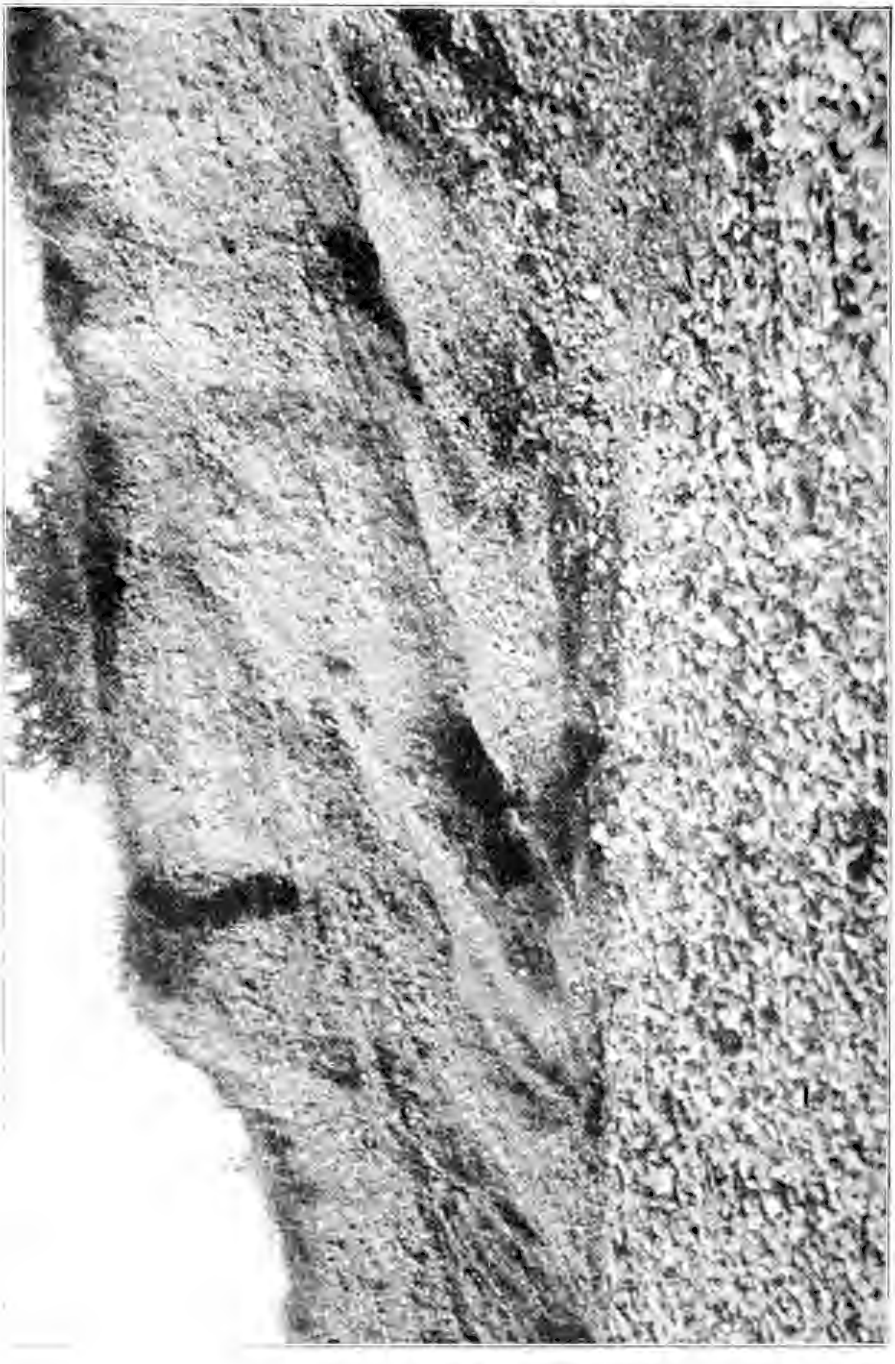

FIG. 148.—*Gravel pit at Rose.* (*Remnant of shore line of Lake Iroquois*).

Fig. 147 shows the condition where the beach is being built up in the form of a ridge, enclosing a swampy or low area behind it.

The lake, in cutting back into the land, displays the character of the material. In some places it is cutting into drumlins (Fig. 130), in others into the loam areas, in others into sand areas and in others into clays, showing horizontal stratification (Fig. 150), all of which have been treated of in the discussion of the soils.

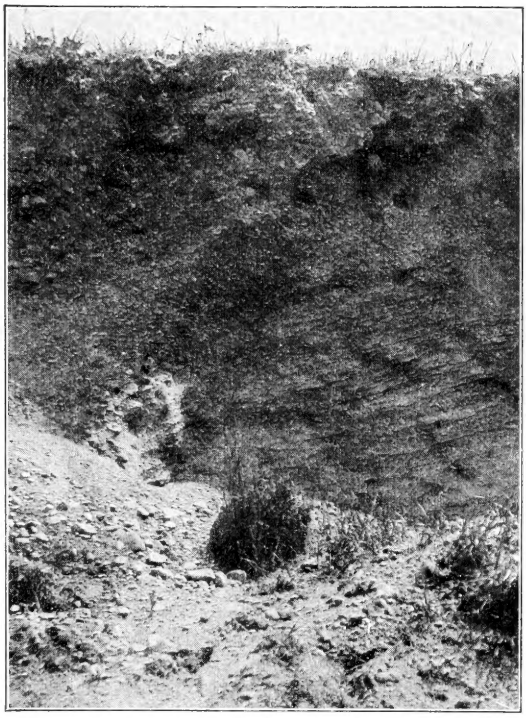

FIG. 149.—*Gravel pit north of Ontario Center.*

RIDGE (OLD LAKE SHORE).

Some of the features of the present lake shore are illustrated in the shore line of the Glacial Lake Iroquois as marked by the ridge (Fig. 108), and the section on the present lake shore was inserted to show this similarity. We find wave-cut cliffs as at Sodus, west of South Sodus and Rose; we find the ridge enclosing low areas behind it and we find the ridge itself almost continuous as far as Sodus. The reason for this is that the lake was receiving far more sediment than it could conveniently dispose of, so it had to deposit it along the shore. The reason why the ridge is not so continuous after leaving Sodus is that here there was a bay where the waters were more quiet and their force was somewhat broken by the drumlins which rose as islands. This ridge is made up of gravel and sand with the variations that are seen in the present lake shore. There is, though, some clay owing to the weathering of the pebbles. Fig. 148 is a cut in a gravel ridge at Rose, which is part of the old shore line.

Investigations show that there has been a tilting of the land in the northeastern portion of our country. In Wayne county the rise from west to east amounts to about a foot for every mile as is shown by levels taken along the ridge for the Rochester and Sodus Bay Electric Railway Company.

NORTH OF THE RIDGE (OLD LAKE BOTTOM).

The topography north of the ridge is quite suggestive of an old lake bottom in that it is quite level (Fig. 100). The nature of the soils, too, is evidence of the existence of this old lake. That has been treated earlier and needs no fuller discussion now. Fig. 149 is a gravel pit north of Ontario Center, which deposit was formed by lake water. Fig. 150 shows stratified clay of lake origin.

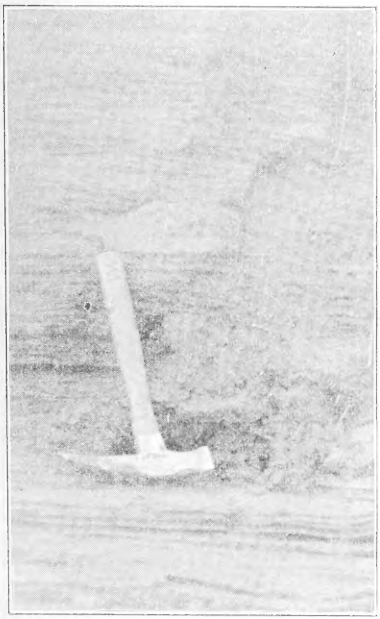

FIG. 150.—*Lake clay three miles east of Sodus Bay.*

The generalized section north of the ridge may be shown by Fig. 151.

From the ridge of gravel north we find a gravelly, sandy area followed by a more sandy and less gravelly area which is in turn followed by a sandy area. Farthest north is the lake clay.

The island drumlins in the old bay of Lake Iroquois are interesting features. Around some of the islands extends a beach mark which is at the same level as the ridge. Areas of stratified material are found associated with these islands. These were deposited in Lake Iroquois: somewhat like bars are being deposited in some bays at the present time.

FIG. 151.—*Generalized section from ridge north to lake shore.*